

INSTRUCTION MANUAL
MODEL 154
PROGRAMMABLE
WAVEFORM GENERATOR

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WAVETEK®

WAVETEK SAN DIEGO, INC.

9045 Balboa Ave., San Diego, CA 92123
P. O. Box 85265, San Diego, CA 92138
Tel 619/279-2200 TWX 910/335-2007

Manual Revision 1/83
Instrument Release W

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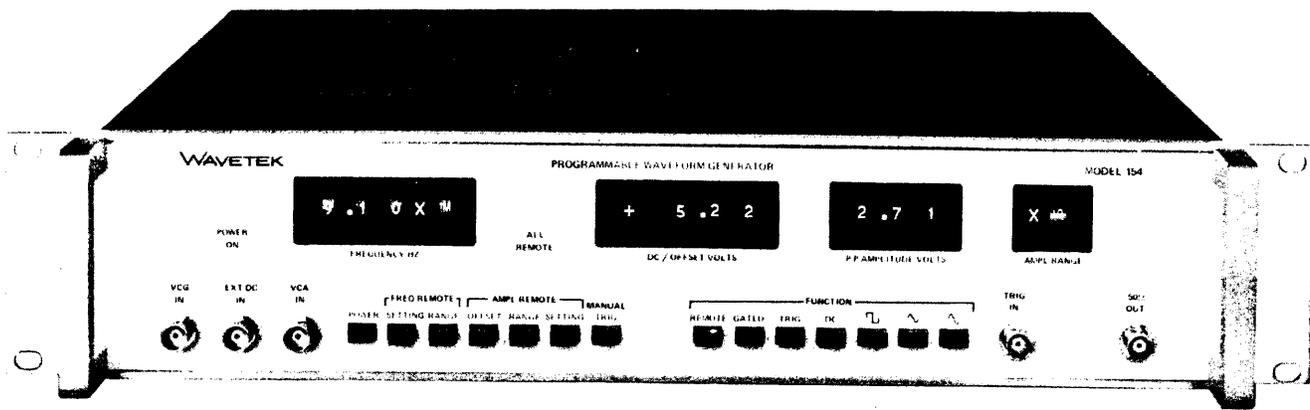


Figure i – Model 154 Programmable Waveform Generator

SCOPE OF THIS MANUAL

This manual provides descriptive material and instructions for the installation, operation, maintenance, and repair of this instrument. Wavetek's product improvement program ensures that the latest electronic developments are incorporated in all Wavetek instruments by the addition of circuit and component changes as rapidly as development and testing permit. Due to the time required to document and print instruction manuals, it is not always possible to incorporate the more recent changes in the released manual. In this case, data will be found on engineering change sheets at the rear of the manual. If no change sheets are included, the manual is correct as printed.

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SECTION 1

INTRODUCTION

1.1 GENERAL CAPABILITIES

The Model 154 Programmable Waveform Generator is a precision source of sine, square and triangle waveforms covering a frequency range from 0.001 Hz to 10 MHz. In addition, a calibrated, programmable dc voltage output is provided. Amplitude, frequency and dc level may be digitally programmed with three digit resolution. Amplitude, frequency and dc level may also be modulated by an analog control voltage. The generator may be operated in continuous, triggered or gated modes. All controls may be locally or remotely programmed. All programming is DTL/TTL compatible.

1.2 PHYSICAL AND ELECTRICAL SPECIFICATIONS

1.2.1 Versatility

Output Signals

DC voltage, Sine , Square  and Triangle  selectable, with auxiliary pulse output.

Frequency Range

0.001 Hz to 10 MHz in 10 decade ranges, with 3 digit resolution.

Main Output

DC voltage, ± 0.1 Vdc to 10 Vdc at 100 mA maximum. Output impedance less than 1Ω . , , , 0.001 V peak to peak to 10 V peak to peak into 50Ω load. Output impedance 50Ω . All waveforms may be offset 5 V above or below ground level with 3 digit resolution and selectable polarity. Signal level plus offset voltage not to exceed ± 7.5 V peak into 50Ω load.

Auxiliary Output

50% duty cycle pulse at generator frequency. Fixed amplitude, 0 to +6 V peak into open circuit (0 to 3 V into 50Ω).

Operating Modes

Continuous, trigger, or gated mode, selectable. The generator may be triggered to produce single cycles by pushbutton trigger or external trigger command. Any discrete number of cycles will be produced by applying a gate signal for the desired burst width when in the gated mode. Minimum voltage required for trigger = +3 V. 50 V can be applied without damage.

Analog Modulation Control

The frequency, amplitude and dc offset level of the generator can be independently controlled by an external voltage. The control can be dc programming or wideband modulation.

1.2.2 Accuracy

Horizontal Precision

Frequency accuracy of the generator, whether programmed manually with front panel switches or remotely by external digital programming:

0.001 Hz to 100 kHz	$\pm(1\%$ of setting +1 digit)
100 kHz to 1 MHz	$\pm(1\%$ of full scale)
1 MHz to 10 MHz	$\pm(2\%$ of full scale)

Vertical Precision

and Waves

0.001 Hz to 100 kHz	$\pm(1\%$ of setting +1 digit)
100 kHz to 1 MHz	$\pm(2\%$ of setting +1 digit)
1 MHz to 10 MHz	$\pm(5\%$ of setting +1 digit)

Wave

0.001 Hz to 10 kHz	$\pm(1\%$ of setting +1 digit)
------------------------------	--------------------------------

Vertical precision stated is for X1 amplitude multiplier. For X0.1, X0.01 and X0.001 add 1% per step.

DC Voltage

$\pm(1\%$ of setting +1% of full scale).

DC Offset

$\pm(1\%$ of setting +1% of range).

1.2.3 Waveform Purity

Stability

Short term	$\pm 0.05\%$ for 10 minutes
Long term	$\pm 0.25\%$ for 24 hours

Percentages apply to frequency, amplitude and dc offset stability.

Time Symmetry

1% to 500 kHz.

Amplitude Symmetry

All waveforms to 500 kHz are symmetrical about ground within $\pm 1\%$ of range maximum p-p amplitude.

Sine Distortion

10 Hz to 100 kHz Less than 0.5%
 0.001 Hz to 1 MHz Less than 1.0%
 1 MHz to 10 MHz . . . All harmonics at least -28 dB

Square Wave

Auxiliary output better than 5 nanosecond rise and fall time with less than 5% aberrations. Main output better than 35 nanosecond rise time with aberrations less than 5% ±10 mV.

Triangle Linearity

Greater than 99%, 0.01 Hz to 100 kHz.

DC Voltage

Ripple and noise less than 10 mV rms with generator idle.

1.2.4 Analog Control Characteristics

Voltage Control of Frequency (VCG)

Up to 1000:1 frequency change with an external voltage input of 5 volts. The upper frequency is limited to maximum of selected range. VCG input impedance 3.3 kΩ.

VCG Response

Bandwidth 100 kHz limited by a slew rate of 2% of range per microsecond.

VCG Linearity

1.0 Hz to 100 kHz ±0.2% of full scale
 0.001 Hz to 1 MHz ±0.5% of full scale

Voltage Control of Amplitude (VCA)

Full amplitude control with an external voltage input of ±5 volts. The control is bipolar, that is, the amplitude can be controlled from maximum through null to range maximum at inverted phase. VCA input impedance is 3.3 kΩ.

VCA Response

Bandwidth 100 kHz limited by a slew rate of 2% of range per microsecond.

VCA Linearity

1% of full scale.

Voltage Control of DC Offset

All waveforms may be offset above or below ground level by an external voltage. Sensitivity of the signal is +2 or -2 volts offset per volt input dependent on dc polarity selected. Input impedance is 3.3 kΩ. Signal level plus offset voltage not to exceed ±7.5 volts peak into 50Ω load.

DC Offset Response

Bandwidth 100 kHz limited by a slew rate of 2% of range per microsecond.

DC Offset Linearity

1% of full scale.

1.2.5 Environmental

Specifications apply at 25°C ±5°C. For operation from 0°C to +50°C, derate all specifications by a factor of 2. Instrument may be stored from -50°C to +80°C without damage.

1.2.6 Mechanical

Dimensions

19-inch rack mount panel, 3½ inches high, 16½ inches deep.

Weight

15 lb. net, 24 lb. shipping.

Power

105 V to 125 V or 200 V to 250 V; 50 to 400 Hz; less than 45 watts.

NOTES

All specifications apply for control settings from 1.00 to 9.99.

On 1 MHz range only X1 and X0.1 amplitude settings apply.

1.3 PROGRAMMING

Description

All functions may be remotely controlled by BCD logic level programming. Front panel push button switches can be used to select local (front panel) control or remote control. When all controls are in the remote position, a logic voltage output is enabled for computer verification as well as illumination of a front panel light for visual verification. Signal ground and program ground are isolated.

Program Requirements

Frequency	3 digits	12 lines
Frequency Range	10 ranges	4 lines
Amplitude	3 digits	12 lines
Amplitude Range	4 ranges	2 lines
DC Level	3 digits	12 lines
DC Polarity	0, + or -	2 lines
Function	∩, □, ∨ or dc	2 lines
Mode	Cont. Trig or Gate	2 lines
Output	Front or rear panel	1 line
Return	2 lines
All remote	Output for verification	1 line

Total No. of Lines for Complete Control 52 lines

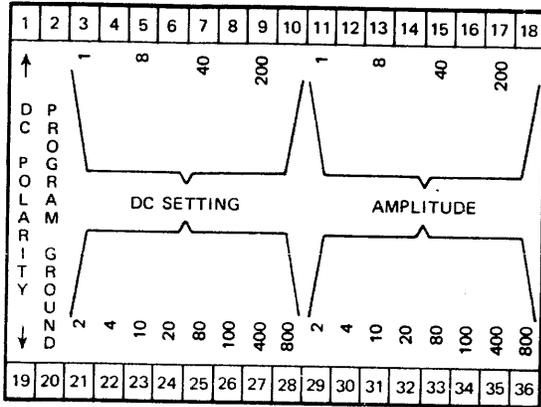
Program Transition Time

Frequency, amplitude and dc offset settings respond in less than 100 μs. Frequency range, function, offset polarity and attenuator respond in less than 3 ms.

CONTROL CONNECTOR PIN LAYOUT

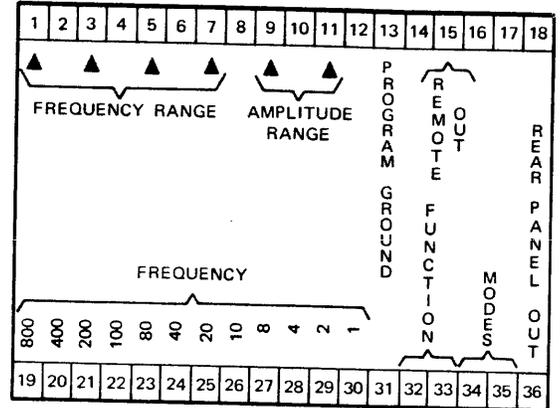
Plug J2

Mating Connector
Amphenol 57-30360



Plug J3

Mating Connector
Amphenol 57-30360



Standard Control Logic

Logic 1 = +2.4 V to +10 V, typical sink current 1.5 mA per line.

Logic 0 = -1 V to +1 V, open circuit voltage is approximately -0.7 V.

TRUTH TABLES WITH PIN ASSIGNMENTS

DC Polarity	Program (Pin No.) 19 1	Frequency Range	Program (Pin No.) 7 5 3 1	Amplitude Range	Program (Pin No.) 11 9	Function	Program (Pin No.) 33 32	Mode	Program (Pin No.) 35 34
+	0 0	0.001	0 0 0 0	0.001	0 0	~	0 0	Continuous	0 0
0	0 1	0.01	0 0 0 1	0.01	0 1	~	0 1	Gated	0 1
-	1 0	0.1	0 0 1 0	0.1	1 0	DC	1 0	No Output	1 0
		1.0	0 0 1 1	1.0	1 1	⌊	1 1	Trigger	1 1
		10	0 1 0 0						
		100	0 1 0 1						
		1 K	0 1 1 0						
		10 K	0 1 1 1						
		.1 M	1 0 0 0						
		1 M	1 0 0 1						

SECTION 2

INSTALLATION AND OPERATION

2.1 MECHANICAL INSTALLATION

After unpacking the instrument, visually inspect all external parts for possible damage to switches, connectors, surface areas, etc. If damage is discovered, file a claim with the carrier who transported the unit. The shipping container and packaging material should be saved in case reshipment is required.

The front panel has been designed to allow this unit to be mounted in a standard 19-inch equipment rack. No mechanical installation is required when the instrument is to be used as a portable bench unit.

2.2 ELECTRICAL INSTALLATION

2.2.1 Power Connection

NOTICE

Unless otherwise specified at the time of purchase, all Wavetek Model 154 instruments are shipped from the factory with the power transformer connected for operation on a normal 115-volt ac line supply, and a ½ amp 115-volt slow blow line fuse.

To convert to 230 volts, set the slide switch at the rear of the instrument to 230, and replace the fuse with a slow blow fuse rated at ¼ amp at 230 volts.

Connect the ac line cord to the mating connector at the rear of the unit.

2.2.2 Signal Connections

Use 50Ω shielded cables equipped with female BNC connectors to distribute all RF signals when connecting this instrument to associated equipment.

2.3 OPERATING CONTROLS

The operating controls and electrical connections for the Model 154 are shown in Figures 2-1 and 2-2. Each of the following paragraph numbers corresponds to a number appearing in Figure 2-1, front panel, and Figure 2-2, rear panel.

1. **Power On Indicator** – The indicator is illuminated when the unit is on.

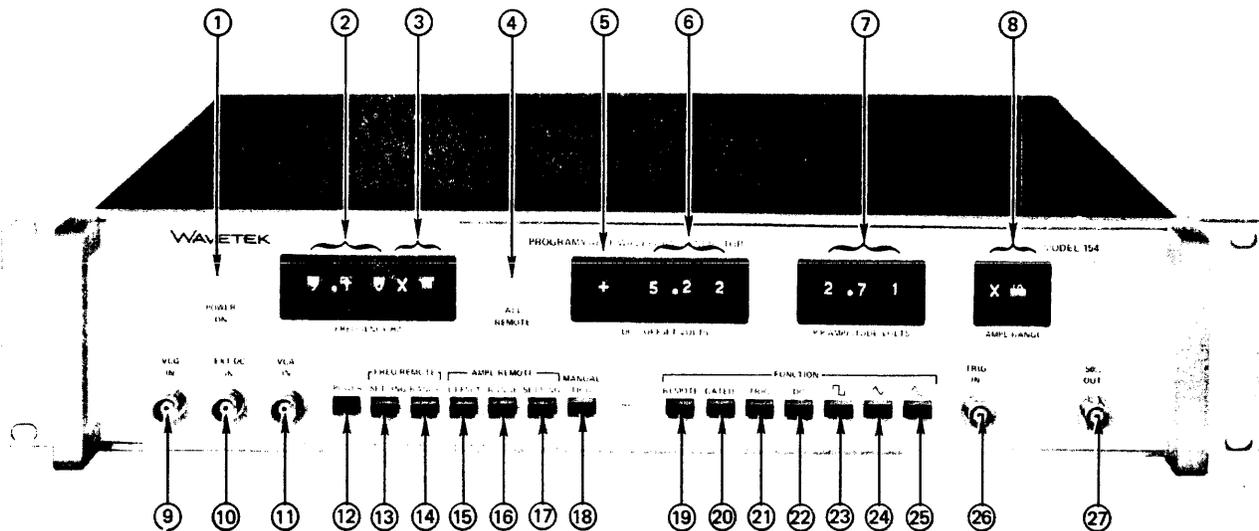


Figure 2-1. Operating Controls, Front Panel

2. **Frequency Hz Setting** – A three-digit thumbwheel switch is provided for output frequency selection. For the actual output frequency, this value is multiplied by the frequency Hz range multiplier (3).
3. **Frequency Hz Range Multiplier** – This thumbwheel switch has ten decade ranges from 1 millihertz to 1 megahertz. This value multiplied by the setting (2) gives the output frequency.
4. **All Remote Indicator** – When all the front panel remote push buttons are in (button Nos. 13, 14, 15, 16, 17 and 19, see Fig. 2-1), the indicator is illuminated. This means the generator is completely controlled by remote programming and independent of the front panel controls. In this condition a signal ($> +3$ Vdc) appears at pin 15 of plug J3 for computer notification.
5. **DC/Offset Polarity** – When in the dc mode, this switch determines the polarity of the dc level, either + or –. When in the “0” position, the dc level will always be zero. When in the , , or  function, this switch controls the polarity of the offset. When in the “0” position, the offset will always be zero.
6. **DC/Offset Volts** – This three-digit thumbwheel switch sets the dc level when in the dc mode, or the amount of dc offset into a 50Ω load for the waveform functions. The maximum voltage of the output amplifier is limited to ± 7.5 volts into 50 ohms; therefore, the peak signal amplitude plus the offset should not exceed this limit or a distorted waveform will be the result. When in the dc mode, the output dc voltage is dependent only on the setting of this switch and independent of the p-p amplitude volt and amplitude range settings and also independent of the load current up to 100 milliamps.
7. **P-P Amplitude Volts** – This three-digit thumbwheel switch is used to set the peak to peak signal level into a 50 ohm load. It controls the level for the sine, triangle and square waves, but has no control in the dc mode.
8. **Amplitude Range** – This switch has four ranges, 1.0, 0.1, 0.01, and 0.001, allowing output amplitudes from 9.99 volts to 1 millivolt.
9. **VCG IN (Voltage Controlled Generator)** – This connector allows external analog control of frequency. Up to a 1000:1 frequency change may be obtained. A positive voltage increases frequency and a negative voltage decreases frequency. See section under OPERATION for details.
10. **EXT DC IN (External DC Offset Control)** – This input allows external analog control of dc offset or of dc voltage output. Sensitivity of the input is +2 or –2 volts offset per 1 volt input dependent on dc polarity selected; i.e., a gain of two. The small signal bandwidth is 100 kHz and the slew rate is 2% of range per microsecond.

The EXT DC IN connector operates in conjunction with any manually or remotely programmed dc level or offset. The signals will be added or subtracted depending on the polarities. If the polarity switch (see 5) is in the “0” position, the EXT DC IN connector is disabled.
11. **VCA IN (Voltage Controlled Amplitude)** – The output amplitude can be modulated by an analog voltage input to this connector. This input signal is algebraically summed with the p-p amplitude setting on the front panel or with the remote program. This input may be used for studying most amplitude modulation techniques.
12. **Power** – Depressing this push button switch turns the unit on.
13. **Frequency Remote, Setting** – The frequency setting (see No. 2) will be controlled by the remote program when this switch is depressed. This does not affect the range multiplier. The setting is 0.00 if the control lines are open and the switch is depressed.
14. **Frequency Remote, Range** – Depressing this switch causes the frequency range to be selected by the remote program. The range will stay at X0.001 if the control lines are open and the switch is depressed.
15. **Amplitude Remote, Offset** – When this push button switch is depressed, the dc voltage output or signal dc offset, including the polarity, is controlled by the remote program. The setting will be +0.00 if the control lines are open and the switch is depressed.
16. **Amplitude Remote, Range** – The amplitude range is remotely controlled when the push button switch is depressed. The range will stay at X0.001 if the control lines are open and the switch is depressed.
17. **Amplitude Remote, Setting** – Depressing this switch causes the amplitude setting to be controlled by the remote program. The setting will be 0.00 with the button depressed and the control lines open.
18. **Manual Trigger** – The manual trigger button operates when the generator is in either triggered or gated mode (see Nos. 20 and 21). In the triggered mode,

- one cycle of the selected waveform is generated each time the button is depressed. In the gated mode, the generator will continue to oscillate while the button is depressed. Upon releasing the trigger button, the generator will complete the last cycle and stop oscillating.
19. **Function Remote** – When this button is depressed, all of the modes under the function heading (Nos. 20 - 25) are under remote control. If this switch is depressed and the control lines are open, the output waveform will be a sine wave in the continuous running mode.
 20. **Gated Mode** – When this switch is depressed, the generator may be started by applying a gating signal of at least 3 volts to the TRIG IN connector (see No. 26). Removing the gating signal causes the generator to complete the last cycle and stop. The generator may also be gated by depressing the manual trigger button (see No. 18).
 21. **Trigger Mode** – In this mode the generator will produce one cycle of output for each trigger signal applied. The frequency of the trigger signal should be lower than the generator frequency. The trigger signal must be at least 3 volts. If both the gated and trigger switches are depressed, the generator will be in the triggered mode.
 22. **DC** – Depressing this button causes a dc output to be present at the 50Ω output connector (see No. 27). The output impedance in the dc mode is 1 ohm. The maximum amount of dc is 10 volts and is set by the dc volts thumbwheel switch (see No. 6). The polarity is determined by the dc polarity switch (see No. 5).
 23.  **(Square Waveform)** – Depressing this button produces a square wave at the 50Ω output connector. Amplitude is controlled by the p-p amplitude volt and amplitude range switches (see Nos. 7 and 8), frequency by the frequency Hz setting and range multiplier switches (see Nos. 2 and 3).
 24.  **(Triangle Waveform)** – This switch applies a triangle waveform to the 50Ω output connector.
 25.  **(Sine Waveform)** – Depressing the button applies a sine wave to the 50Ω output connector.
 26. **TRIG IN** – This connector accepts the trigger input signal for operation in either the trigger or gated mode (see Nos. 20 and 21). The trigger signal should be at least 3 volts. The input is dc coupled with 10K ohm impedance. Up to a 50 volt signal may be applied without damage.
 27. **50Ω OUT** – This is the main output connector for all output signals. The signal will always be here unless the generator has been programmed to direct the output to the rear connector.
 28. **AUX OUT** – This is an auxiliary pulse output. It is 0 to +6 volt pulse with 50% duty cycle. It can be used as a pulse, sync or squarewave output. It runs at the same frequency as the main generator. The rise and fall time is less than 5 nanoseconds.

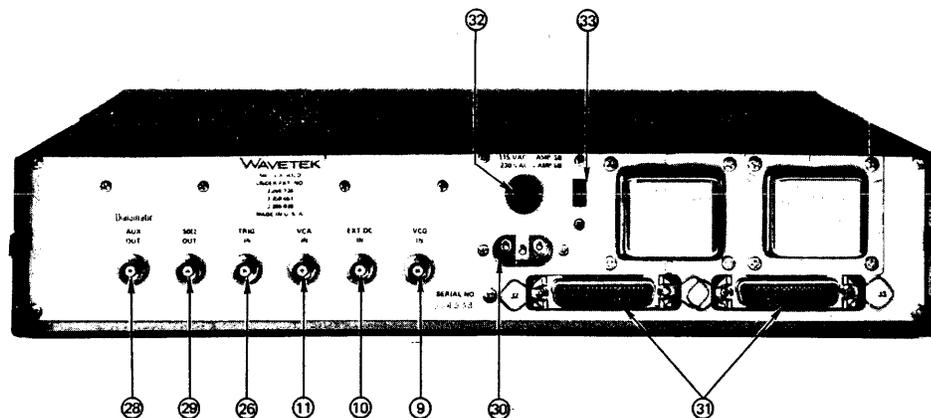


Figure 2-2. Operating Controls, Rear Panel

29. **50 Ω OUT** – The main output is shifted to the rear output connector when pin No. 36 of connector J3 is programmed with a +2.4 V to +10 V signal. (See Section 1.3.)
30. **Power In Receptacle** – This connector accepts a female power cord for applying 120 or 240 volts ac.
31. **Remote Programming Connectors** – Remote control signals are input to the generator through these connectors. All control logic is BCD. (See Section 1.3 for pin assignments.) The mating connector (Part No. 57-30360) is manufactured by Amphenol.
32. **Line Fuse** – This fuse protects the instrument from ac line transients as well as shorts within the instrument. For 115 Vac operation, use a ½ amp slow blow fuse. For 230 Vac, use a ¼ amp slow blow fuse.
33. **115 - 230 Volt Switch** – This switch selects the power input voltage used. The instrument is normally shipped for 115 Vac and a ½ amp fuse. To convert to 230 Vac, set slide switch to 230 and install a ¼ amp slow blow fuse.

2.4 INSTALLATION CHECKS

This paragraph outlines a quick checkout procedure to determine if the instrument is operating properly. Field calibration and checkout instructions are given in Section 4 to determine compliance with electrical specifications. If electrical deficiencies exist, refer to the warranty on the back of the title page.

Use a Tektronix Model 454 oscilloscope (or equivalent) and a 10 MHz counter-timer with 4-digit resolution when performing these installation checks.

1. Connect the line cord to the ac line.
2. Connect the 50 Ω OUT BNC to oscilloscope with 50 ohm cable terminated with 50 ohms.
3. Set frequency Hz to 1.00 X 1K.
4. Set DC/OFFSET VOLTS to 0 0.00.
5. Set P-P AMPLITUDE VOLTS to 1.00.
6. Set AMPL RANGE to X1.0.
7. Set generator up for complete manual control; that is, see that none of the remote buttons is depressed.
Depress  push button.
9. Depress POWER push button.
10. Observe a 1 volt p-p square wave at 1 kHz on the oscilloscope.
11. Depress  and then  push buttons. Observe triangle and sine waveforms, respectively.
12. Depress TRIG push button. Press MANUAL TRIG button several times and observe single cycle generation. Return TRIG button to out position.
13. Depress GATED push button. The generator should run as long as the MANUAL TRIG button is depressed. Return GATED button to out position.
14. With FUNCTION still on  and amplitude at 1.00 X 1.0, set DC/OFFSET VOLTS to +5.00. Rotate most significant decade from 5 to 0. Change polarity to -. Rotate same switch from 0 to 5. Observe sine waveform being offset, first positively, then decreasing to zero and then increasing negatively over the range of ± 5 volts. See Section 2.3, number 6, for signal plus offset limitations on the output amplifier. Return DC/OFFSET VOLTS to 0 0.00.
15. Set P-P AMPLITUDE VOLTS to 9.99. Rotate most significant decade from 9 to 0 and note proper operation of amplitude setting control.
16. Return P-P AMPLITUDE VOLTS to 9.99. Rotate AMPL RANGE control through all positions and note 20 dB change in amplitude per step. Return AMPL RANGE control to X1.0.
17. Remove 50 ohm terminator. Reconnect scope. Depress DC push button. Set DC/OFFSET VOLTS to +9.00. Observe 9 volt dc level. Rotate most significant decade of DC/OFFSET VOLTS thumbwheel switch from 9 to 0 and observe dc level decrease. Set polarity to - and rotate the same digit from 0 to 9. Observe dc level increasing negatively. Return DC/OFFSET VOLTS to 0 0.00.
18. Disconnect output BNC cable to oscilloscope and reconnect to a counter with 50 ohm terminator.
19. Rotate frequency setting and range multiplier switches and observe counter to verify proper frequency calibration.
20. Remote programming may be checked by applying dc levels (+2.4 to +10 V) to the appropriate pins of plugs J2 and J3 to verify that the output is correct. Use the Truth Tables with Pin Assignments in Section 1.3 to

determine which pins must receive a signal for a specified output.

2.5 OPERATING PROCEDURE

No preparation for operation is required beyond completion of the initial installation checks given in paragraph 2.4 of this manual. It is recommended that a one-half hour warm-up period be allowed for the associated equipment to reach a stabilized operating temperature and for the Model 154 to attain stated accuracies.

2.5.1 Operation as a Function Generator

1. Properly terminate the 50Ω OUT connector with 50Ω ±1% termination.
2. Select the desired waveform either from the front panel push buttons or by the remote program. If the remote mode is used, the FUNCTION REMOTE push button must be depressed.
3. Set FREQUENCY HZ setting and range multiplier for desired output frequency. If a remote program is used, be sure FREQ REMOTE SETTING and/or RANGE push buttons are depressed as required.
4. Set P-P AMPLITUDE VOLTS and AMPL RANGE multiplier for desired output amplitude. If a remote program is used, depress either or both AMPL REMOTE RANGE and SETTING push buttons as desired.
5. A positive or negative dc offset may be applied to the waveform by setting the DC/OFFSET VOLTS to the desired level. The peak signal value plus the offset cannot exceed ±7.5 volts. If it is desired to control the offset by the remote program, the AMPL REMOTE OFFSET push button must be depressed.

2.5.2 Operation as a Voltage Controlled Generator

The VCG input connector can be used to externally control the frequency of the generator. If a positive voltage is applied to the VCG input terminal, the frequency will increase from the dial setting. A negative voltage will cause the frequency to decrease from the dial setting. The VCG range of the Model 154 is 1000:1. The nomograph of Figure 2-3 shows the characteristics of the VCG circuit. Column A gives the frequency setting, column B, the VCG voltage and column C, the resultant frequency of the generator.

The following are examples of setting up the generator for several ranges of frequency change.

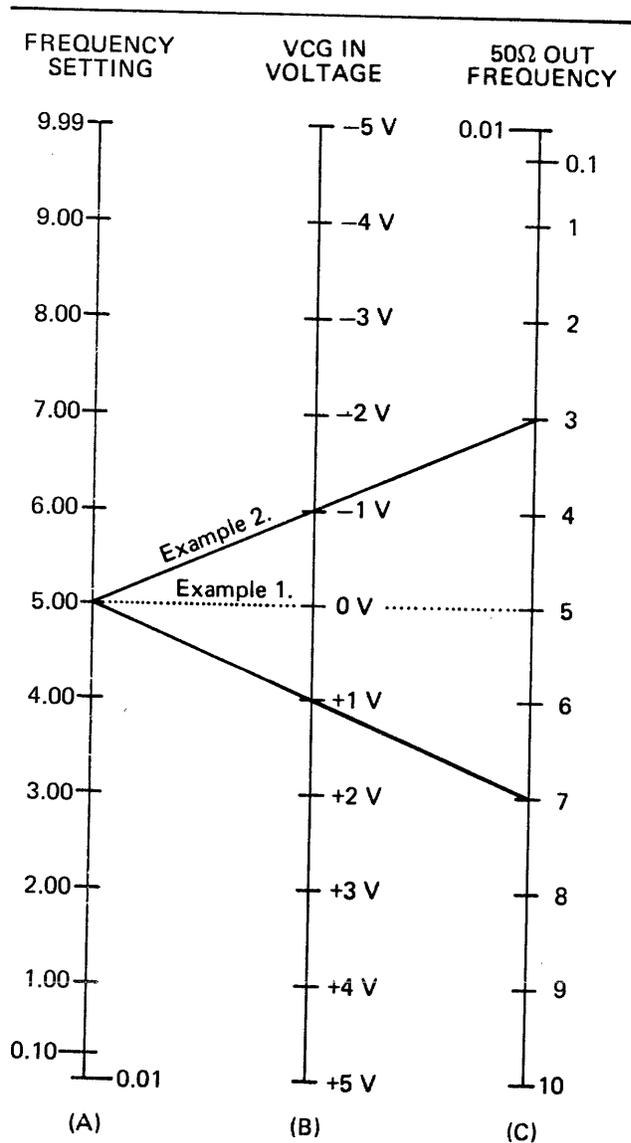


Figure 2-3. VCG Voltage-to-Frequency Nomograph

In example 1, the frequency setting is 5.00 and 0 volts VCG input voltage is applied. Extend a straight line from 5.00 (frequency setting) through 0 volts (VCG voltage). The result is an output frequency of 5 (multiplied by the range multiplier).

In example 2, the frequency setting is 5.00 and a varying VCG voltage of -1 V to +1 V is applied. By extending straight lines through the appropriate position it can be seen that the frequency will vary from 3 to 7 (multiplied by the range multiplier).

To obtain a maximum frequency change of 1000:1 the low frequency must have a setting of 0.01 X the multiplier. The maximum top frequency will then be 9.99 X the multiplier, thus giving a 1000:1 change.

For example, suppose an increasing sweep from 10 kHz to 10 MHz is desired. The VCG input must be a 0 to +5 volt ramp. The frequency setting must be $0.01 \times 1\text{M}$ which equals 10 kHz (the low frequency). At a +5 volt input the generator will be at the full scale output ($9.99 \times 1\text{M}$) or 10 MHz.

As another example, sweep down from 1 kHz to 1 Hz. The VCG input must be a 0 to -5 volt ramp. The frequency setting must be 9.99×100 which equals 1 kHz, the high frequency. At a -5 volt input the generator will be at the minimum allowed output for the X100 range (0.01×100) or 1 Hz. These examples may be verified by using the nomograph in Figure 2-3.

2.5.3 Operation as a Triggered Generator

1. Select the desired waveform by depressing the corresponding FUNCTION push button. If remote control is used, depress the FUNCTION REMOTE push button and program the remote connector as required.
2. Set or program generator to the desired frequency.
3. Depress the TRIG push button. If remote control is used, depress FUNCTION REMOTE. Apply +2.4 to +10 volt logic levels to pins 34 and 35 of plug J3. (See the Truth Tables in Section 1.3.)
4. Apply an external trigger signal of at least +3 volts to the TRIG IN connector or depress the MANUAL TRIG push button for generation of one cycle of the selected waveform. One cycle output will be generated for each input signal, providing the frequency of the trigger signal is lower than the generator frequency.

2.5.4 Operation as a Gated or Tone Burst Generator

1. Select the desired waveform by depressing the corresponding FUNCTION push button. If remote control is used, depress the FUNCTION REMOTE push button and program the remote connector as required.
2. Set or program generator to the desired frequency.
3. Depress the GATED push button. If remote control is used, depress FUNCTION REMOTE. Apply +2.4 to +10 volt logic level to pin 34. No signal is applied to pin 35.
4. Apply an external gating signal of at least +3 V to the TRIG IN connector or depress the MANUAL TRIG button. A gated or tone burst signal will be generated as long as gating signal is applied to TRIG IN or MANUAL TRIG is depressed.

2.5.5 Operation as a DC Voltage Source

Model 154 may be used as a calibrated dc voltage source not to exceed 100 mA of current as follows:

1. Set the generator in the triggered mode either by depressing the TRIG push button or by the remote program. See 2.5.3, Step 3. This inhibits the generator from running which minimizes the noise content of the dc.
2. Set the function to DC either locally or by remote program. The output impedance at the 50Ω OUT connector is now less than 1 ohm.
3. Connect the 50Ω OUT connector to the device under test.
4. Set or program the DC/OFFSET VOLTS to the desired value, either positive or negative. The dc voltage ranges from 9.99 to 0.01. The ripple and noise is less than 10 mV with the generator idle.

2.5.6 Operation as an Amplitude Modulated Generator

The VCA IN connector provides an input for amplitude modulation. In using the VCA capability of the generator, refer to Figure 2-4.

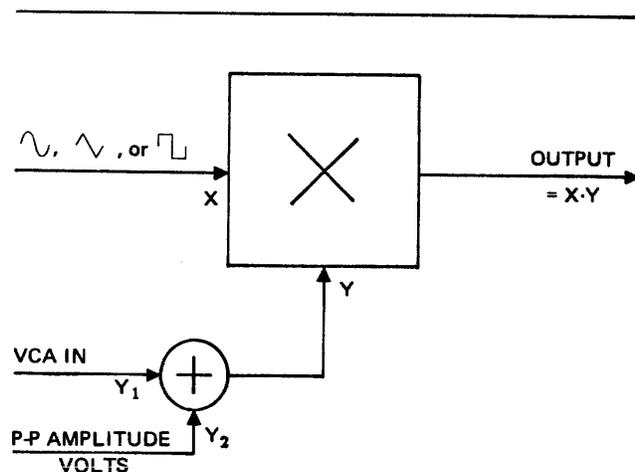


Figure 2-4. X-Y Multiplier Block Diagram

The output of the generator is the product of the X and Y inputs; that is, the generator signal times the sum of the VCA IN plus the p-p amplitude, or output = $X(Y_1 + Y_2)$. Y_2 is always a positive dc level, internal to the generator, which controls the output amplitude, if there is no VCA IN signal. Any VCA input, whether dc or ac, adds to Y_2 . If the sum of Y_1 and Y_2 exceeds the output capabilities of the generator, a clipped waveform will result.

The modulated output of the generator with several different VCA input conditions is shown in Figure 2-5. The P-P AMPLITUDE VOLTS control is assumed to be 0.00.

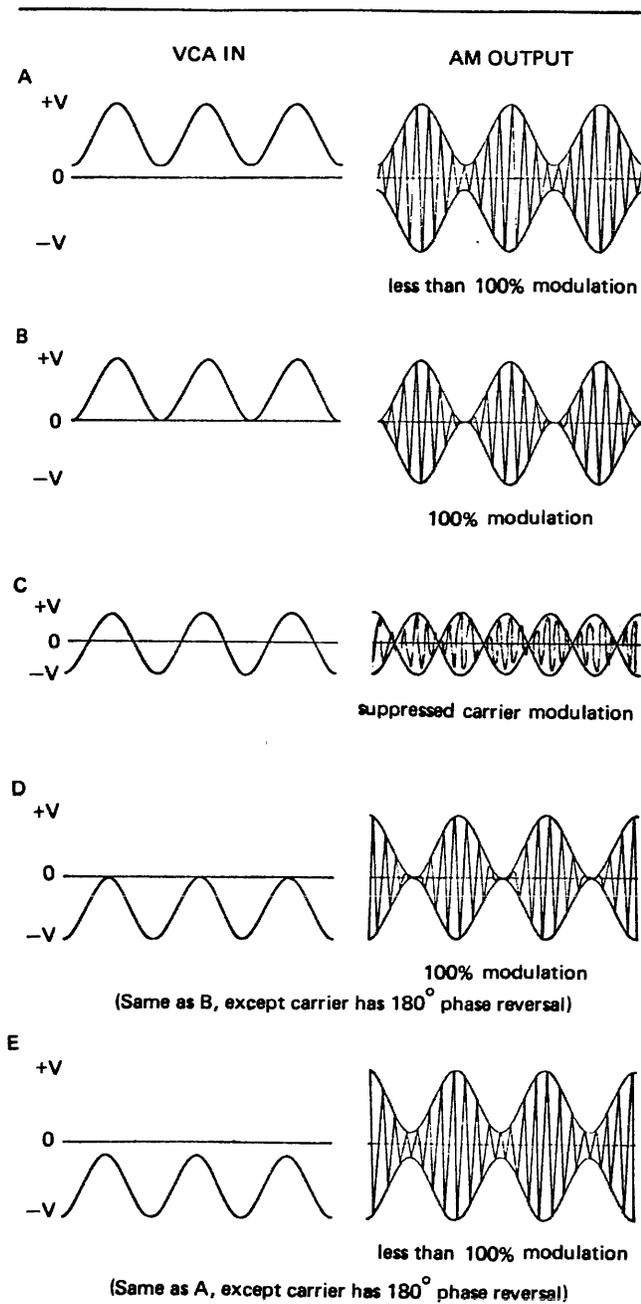


Figure 2-5. Amplitude Modulation Input and Resultant Output

The nomograph in Figure 2-6 is provided to determine the peak limits of the amplitude modulated output.

Example 1 displays suppressed carrier modulation. See Figure 2-5, Diagram C, for a display of the VCA input waveform and the resultant modulated output.

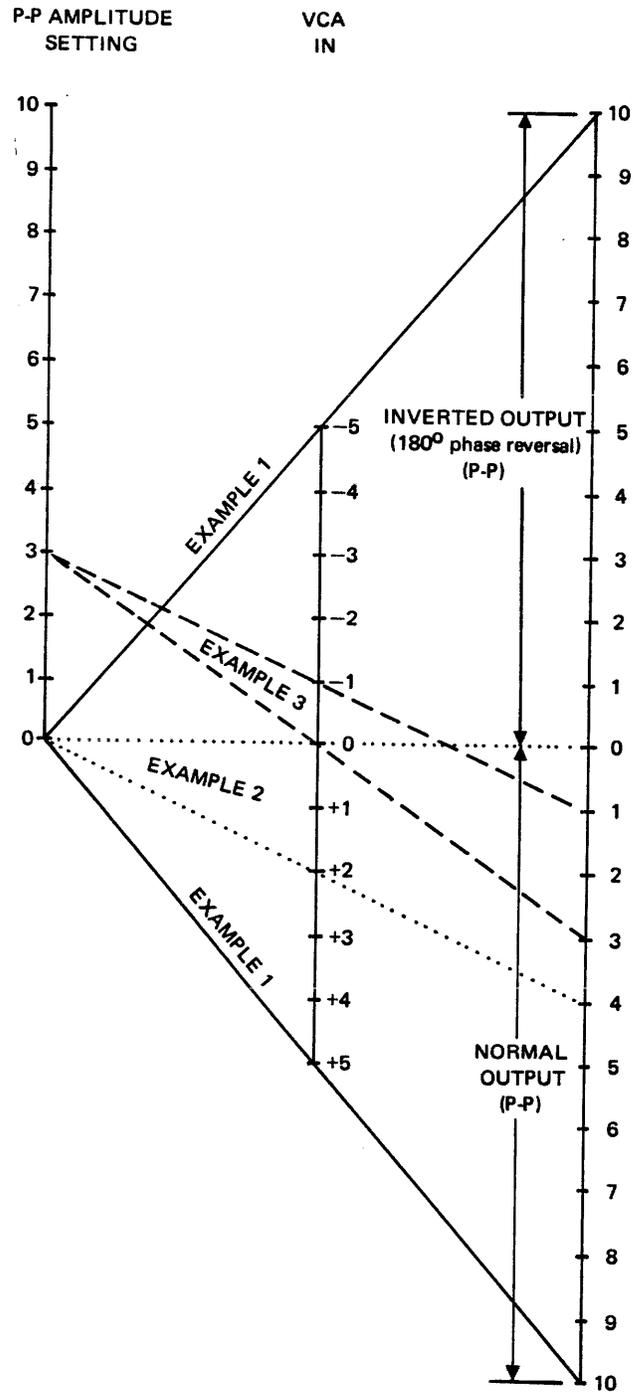


Figure 2-6. Amplitude Modulation Nomograph

Example 2 shows 100% modulation. The envelope is 4 volts peak to peak. The input sine wave is 2 volts p-p with the negative peak equal to zero as referenced to signal ground of the Model 154. See Figure 2-5, Diagram B, for waveform display.

Example 3 shows the effect of using the p-p amplitude control together with a VCA input. The result is less than 100% modulation, since the p-p amplitude control has offset the VCA input above signal ground. The effect is shown in Diagram A of Figure 2-5.

2.5.7 Remote Operation

The Model 154 may be partially or totally operated in the remote mode. Refer to Figure 2-1.

All of the following should be noted when using a remote program.

1. Be sure logic levels are compatible with those stated in Section 1.3.
2. Be sure plugs J2 and J3 are wired correctly according to the pin layout in Section 1.3.
3. Some or all functions may be programmed at any one time. See Section 2.3, paragraphs 13 through 19.
4. When the generator is completely under remote control, a front panel light will be illuminated as well as a signal generated at pin 15 of J3.
5. The analog program applied to the VCG IN, VCA IN and/or EXT DC IN are additive to the digital program.
6. The 50 Ω OUT is normally at the front panel, but may be programmed to appear at the rear panel connector by applying a signal to pin 36 of connector J3. The waveform quality at high frequencies will be better at the front panel output.

CAUTION

At no time should voltage be applied to the instrument that will cause the potential between signal ground and program ground to exceed 10 Vdc.

CIRCUIT DESCRIPTION

3.1. GENERAL DESCRIPTION

3.1.1 VCG Generator

A simplified block diagram of the VCG generator is shown in Figure 3-1. Triangle and square signals are generated simultaneously in the triangle generator circuit. The triangle is then applied to a sine converter and amplified.

The frequency is controlled by the current from the VCG amplifier which in turn is controlled by the voltage from the VCG D/A converter.

One of the signals, square, triangle, sine or DC, is fed into the X-Y multiplier and the amplitude is controlled by the VCA D/A converter.

The signal is then fed into the output amplifier. The amount of dc offset is controlled by the voltage from the dc offset D/A converter. The square wave from the triangle generator circuit is also fed into a fast switching circuit, a pulse amplifier, to generate a fixed amplitude fast square wave output.

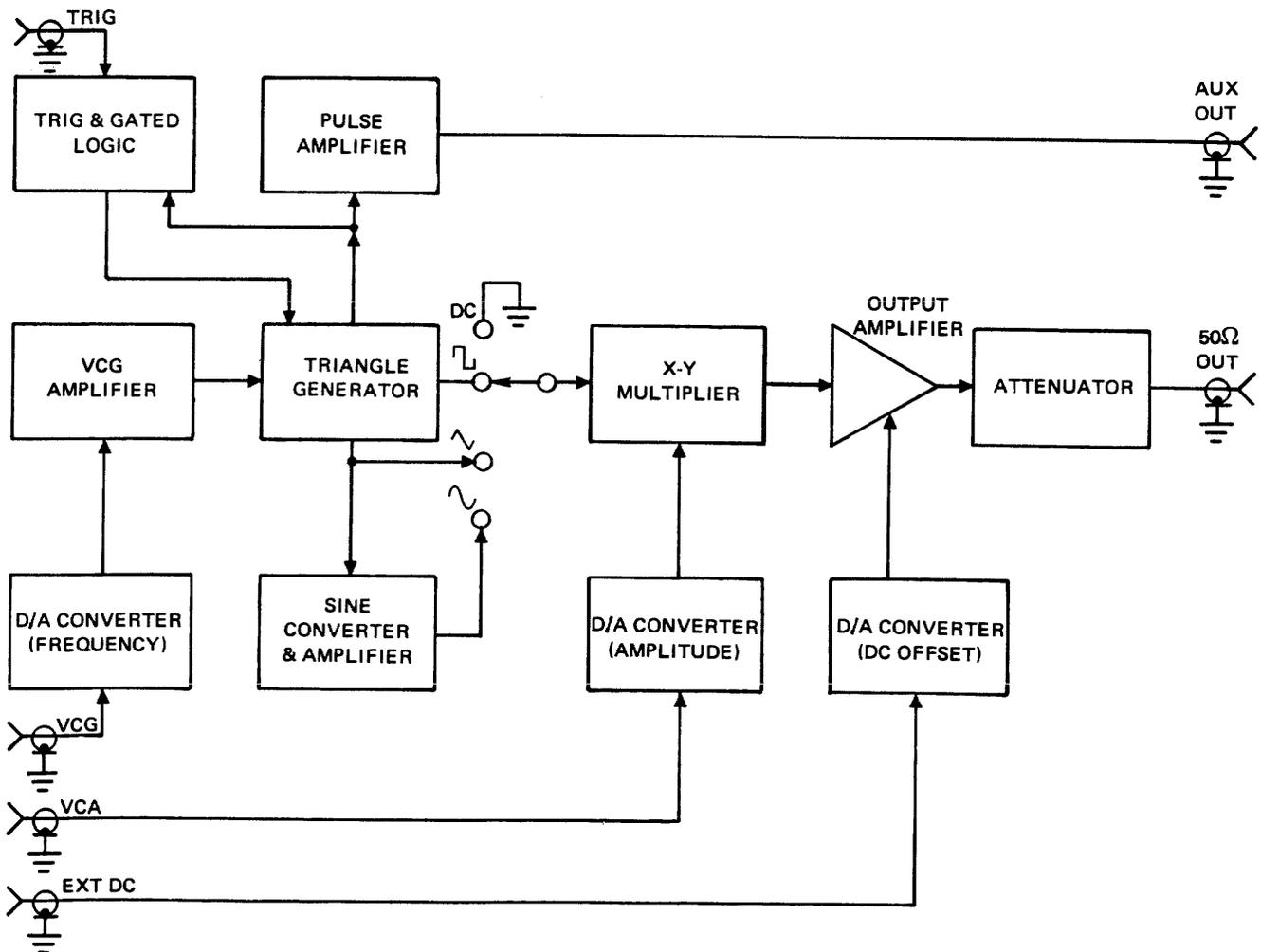


Figure 3-1. VCG Generator Block Diagram

3.2 THEORY OF OPERATION

3.2.1 Triangle Generator

When the voltage at point D is positive, the diodes CR15 and CR16 are reverse biased and CR14 and CR17 are forward biased. See Figure 3-2. Therefore, the current $I+$ is charging the capacitor C which causes the voltage at points A and B to rise. As soon as the voltage at point B reaches +1.25 V, the output of the hysteresis switch will switch negative and thus reverse the current flow. The current $I-$ is drawn from capacitor C. Again, the hysteresis switch will switch positive when the voltage at B is below -1.25 V. Thus, triangle and square signals are generated simultaneously.

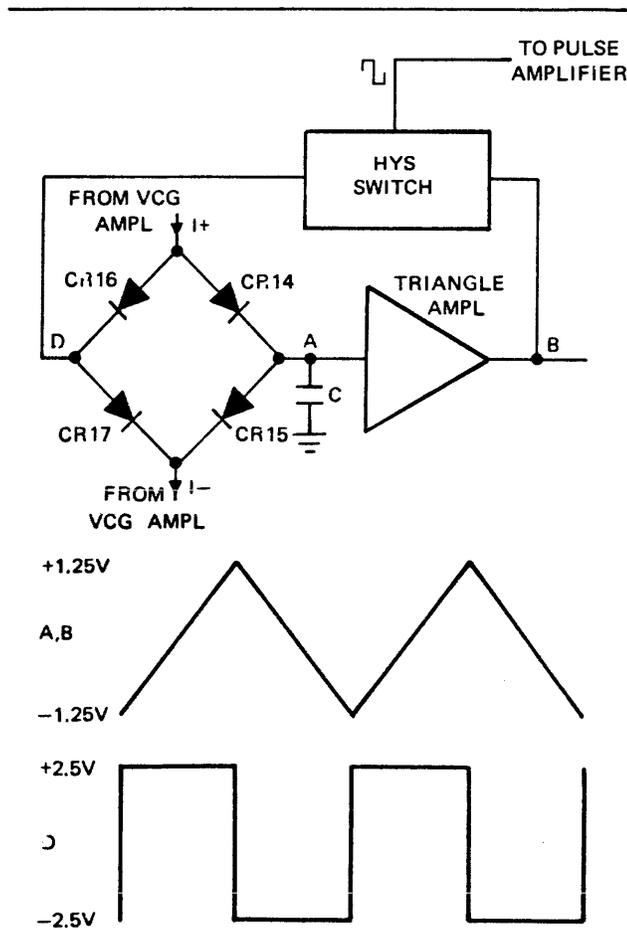


Figure 3-2. Triangle Generator Block Diagram

The output frequency depends on the size of the capacitor selected and the amount of currents, $I+$ and $I-$, charging the capacitor. The currents are controlled by the VCG amplifier which in turn is controlled by the voltage from the D/A amplifier and VCG input.

3.2.2 VCG Amplifier and Current Sources

The voltage used to control the output frequency from the D/A amplifier is applied to point A of the VCG amplifier. See Figure 3-3. Two ICs are used to shift the control voltage ground reference to the power supply reference. The other two ICs are the current source generators. The two current outputs are fed to the triangle generator.

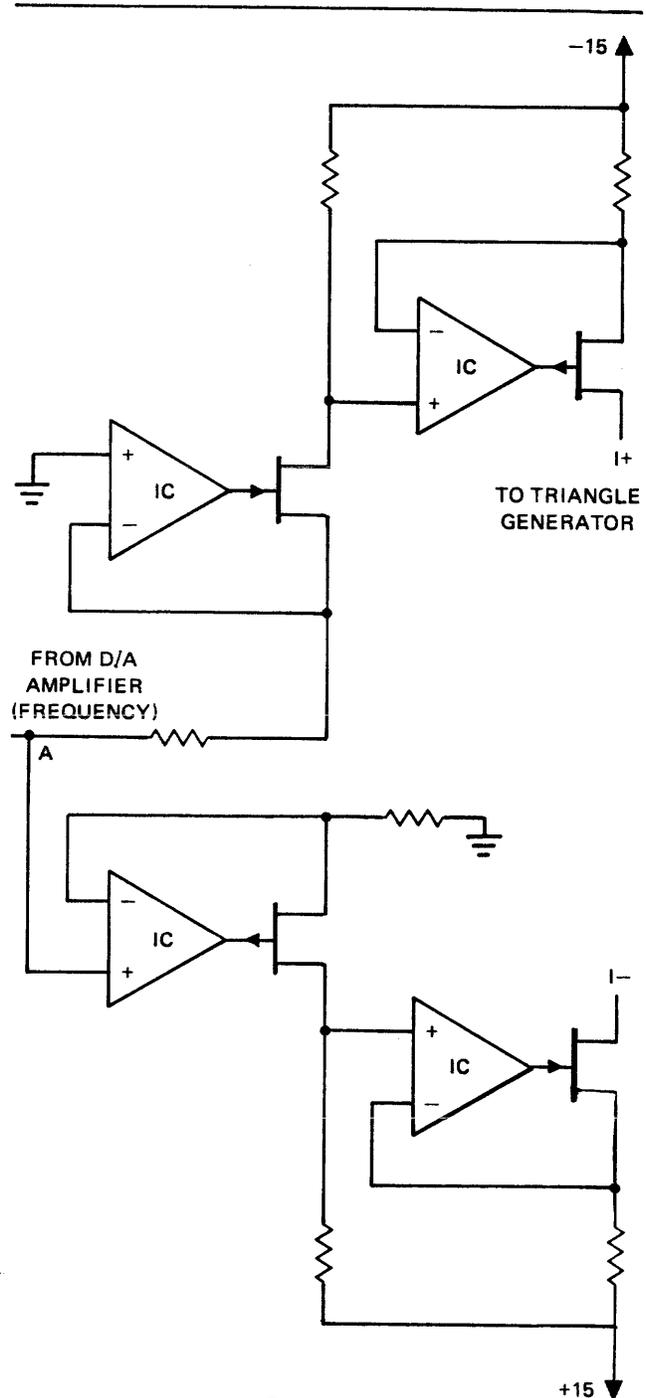


Figure 3-3. VCG Amplifier and Current Source Simplified Circuit

3.2.3 Capacitance Multiplier

Frequency ranging is achieved by selecting different capacitors. For frequency ranges at X1 Hz or below, large capacitors are necessary and, therefore, impractical. Instead, a capacitance multiplier circuit is used, and ranging is achieved by changing the multiplication factor which is equivalent to the ranging resistors. The simplified circuit is shown in Figure 3-4.

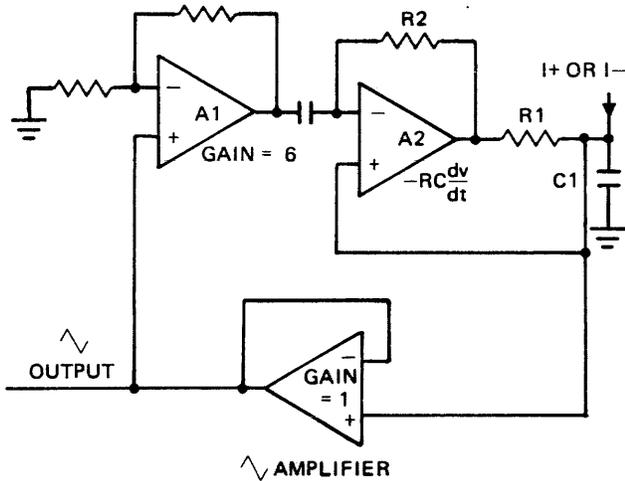


Figure 3-4. Capacitance Multiplier Simplified Circuit

Because of the nature of the feedback loop connection, A1 and A2, most of the current, $I+$ and $I-$, will be drawn by A2 through R1. Only a very small percentage of current is changing and discharging capacitor C1. Therefore, the output frequency will appear much slower. The percentage of current drawn by A2 is precisely controlled by the loop gain and time constant of the capacitance multiplier circuit. Frequency ranging is achieved by changing R2.

3.2.4 X-Y Multiplier and Output Amplifier

One of the signals is selected and fed into one input of the X-Y multiplier, and a control voltage from the D/A amplifier is fed to the other input. Refer to Figure 3-5. The differential output from the X-Y multiplier is directly proportional to the product of two inputs.

The signal is then fed into the output amplifier which consists of two inverting amplifiers. The combined operation of the two amplifiers is exactly equal to one differential amplifier. Because of the large common mode rejection of this amplifier, the output amplifier ground, " ∇ ", can be floated from all other grounds, " \equiv ". A separate power supply would be required in this case.

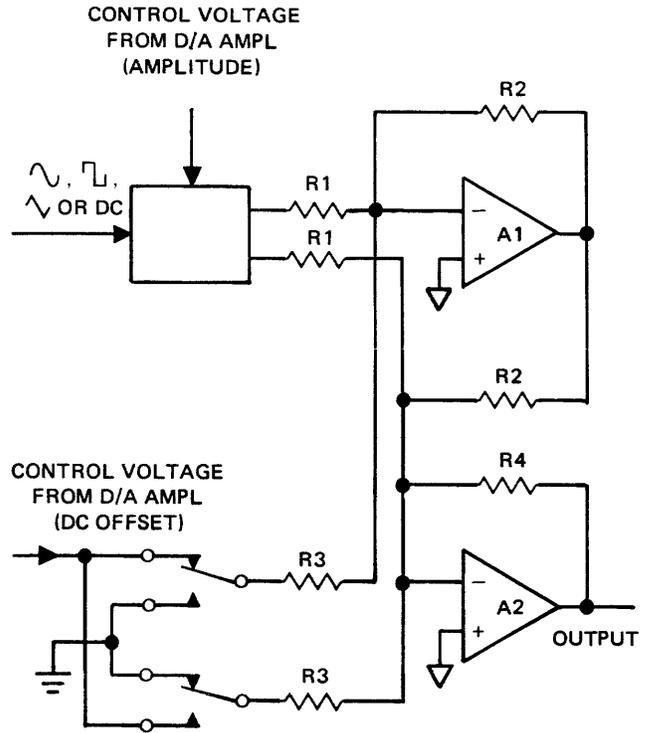


Figure 3-5.

X-Y Multiplier and Output Amplifier Simplified Circuit

3.2.5 Trigger Gated Modes

The triangle generator will oscillate continuously only if the voltage at G is negative which reverse biases CR11. Refer to Figure 3-6. This requires that the voltage at E or F be negative. If both voltages at E and F are positive, then so is the voltage at G. The current through CR11 will keep the voltage of C from falling below zero, because CR12 is clamped at zero. This stops the generator from oscillating.

The JK flip-flop is used to control the timing so that the triangle will always stop at the end of the cycle. The triangle will stop at time t_3 , if the trigger signal is reset between times t_1 and t_3 as shown in the timing diagram.

If the signal at B is differentiated before it is applied to the JK flip-flop, only one cycle of the triangle signal will be generated for each trigger input.

3.2.6 D/A Converter

Diode gates are used to switch the voltage through weighting resistors into the summing node of an amplifier. Refer to the D/A Converter Schematic.

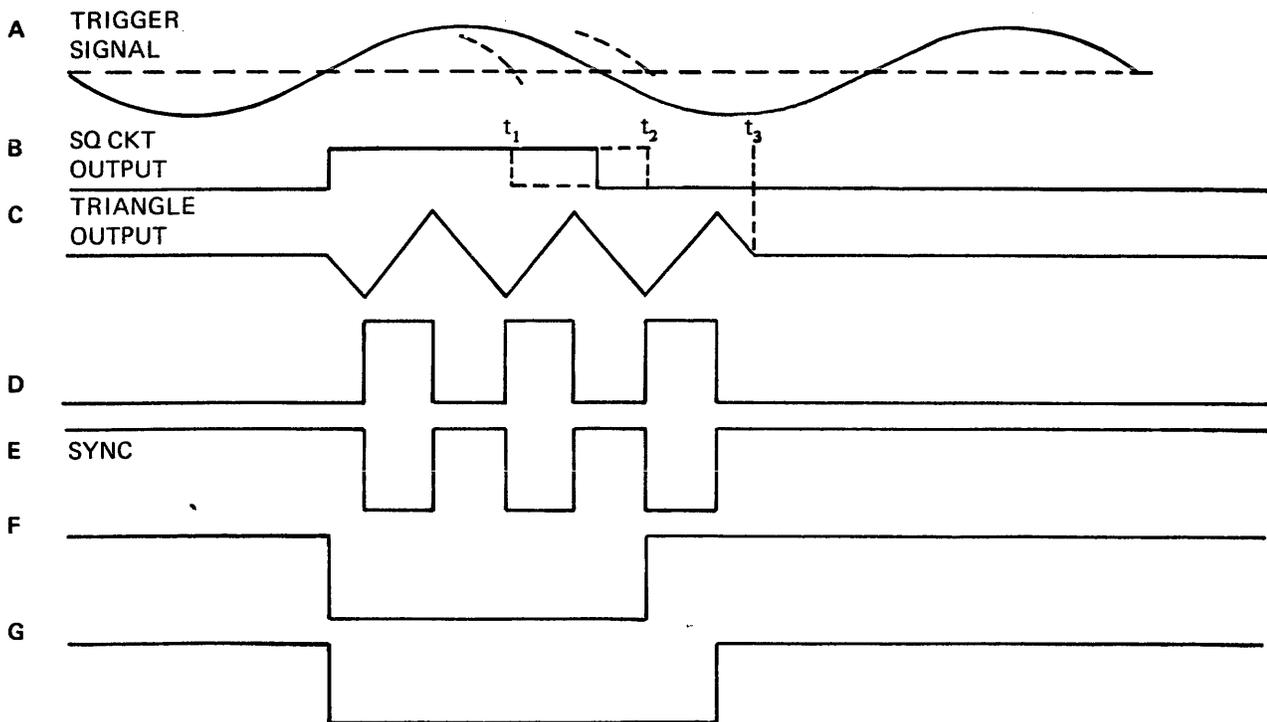
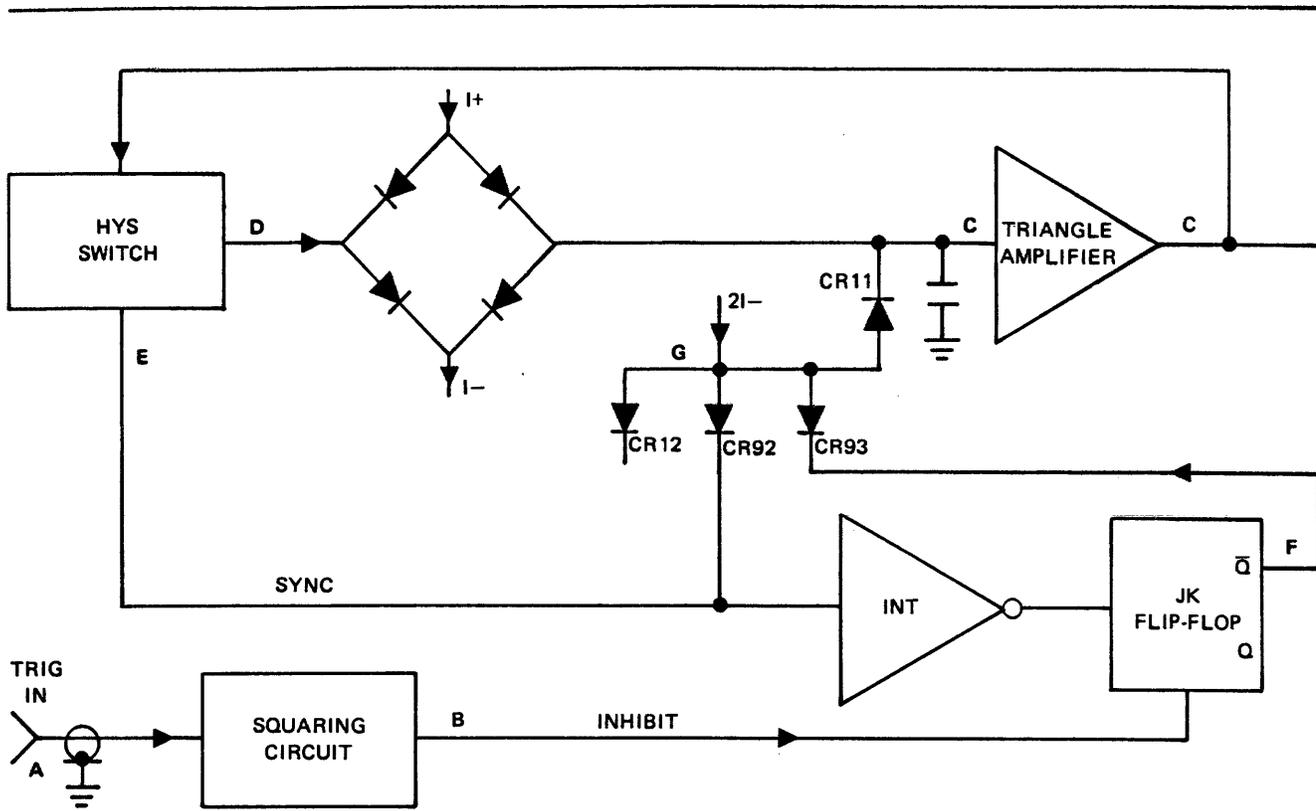


Figure 3-6. Trigger Gated Block and Timing Diagrams

4

SECTION 4

CALIBRATION AND MAINTENANCE

4.1 INTRODUCTION

This section provides instructions for testing, calibrating, troubleshooting, and repairing the Model 154 generator. The instructions are concise and written for the experienced electronics technician or field engineer. Wavetek maintains a factory-repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to facilitate the turnaround time. The main board test point and adjustment locations are shown on the board itself, and all points are illustrated in the data package.

4.2 ACCESS INSTRUCTION

Removal of the top dust cover affords quick access to all the components within the unit. However, it may be necessary to remove the bottom dust cover to replace the components.

An extender board (located in the front left corner) is provided to allow testing and repair of individual boards while still in the circuit. To remove the extender board, remove the two screws located on the side panel.

4.2.1 Removing the Dust Cover

1. Unplug the power cord.
2. Unscrew two captive screws on top cover.
3. Remove top cover.
4. Follow same procedure for bottom cover removal.

4.3 RECOMMENDED TEST EQUIPMENT

Table 4-1 contains a list of recommended test equipment. Any test equipment having equivalent accuracies may be substituted for those listed.

Table 4-1. TEST EQUIPMENT

Type	Required Characteristics	Recommended	
		Manufacturer	Model
Oscilloscope	To 250 MHz	Tektronix	454
Oscilloscope	To 30 MHz	Tektronix	544
Plug-In	Dual Channel	Tektronix	1A1
Plug-In	Peak mV measuring capability	Tektronix	1A5
Distortion Analyzer	To 600 kHz	Hewlett-Packard	334A
Spectrum Analyzer Display	To 50 MHz	Hewlett-Packard	141S
IF Section		Hewlett-Packard	8552A
RF Section		Hewlett-Packard	8553L
Differential Voltmeter	Microvolt dc measurement		
Counter-Timer	To 10 MHz 0.1% of reading accuracy		

4.4 CALIBRATION INSTRUCTIONS

The following paragraphs provide complete sequential calibration procedures for the Model 154 generator.

NOTE

The entire calibration procedure must be read first to determine initial control settings and test equipment connections required before attempting recalibration. The steps of this procedure should be performed in the sequence given, and the parts within each step should also be performed in the same sequence given. Fold out page 4-21 for Adjustment and Test Point Locations.

NOTE

Unless otherwise noted, all measurements made at the 50Ω OUT connector should be terminated into a 50Ω load when in \sim , \wedge , or \sqcap modes and unterminated when in DC.

4.4.1 Preliminary Procedures

Allow the unit to warm up for at least 30 minutes. Start the calibration by setting the front panel switches and controls as follows:

POWER Switch ON (IN)
 FUNCTION Switch \sim
 All other push button switches should be in the OFF (OUT) position.
 FREQUENCY 9.99 X 100
 DC/OFFSET 0 0.00
 AMPLITUDE 5.00 X 1.0

4.4.2 Power Supply Regulation

1. Connect a voltmeter to R5 (marked "+15 V" in \wedge AMPL section of the main board), and ground at TP1 (C15).
2. Adjust voltage to +15 Vdc \pm 20 mV, using R21 on the 15 V power supply board.
3. Check for approximately -15 volts at R7 (marked "-15 V" in \wedge AMPL section of the main board).
4. Check for approximately +24 volts at R4 and -24 volts at R3 in \wedge AMPL section of the main board. Test points are marked "+24 V" and "-24 V".
5. Connect a voltmeter to +23 volts across C72 (OUTPUT AMPL section of main board). Adjust voltage to +23 Vdc \pm 20 mV using R21 on the 23 V power supply board.
6. Check voltage across C70 for -23 Vdc \pm 400 mV.
7. Check the +6 volt supply in AUX AMPL section of main board and ground at TP1 (C15). Voltage should be +6 Vdc \pm 200 mV.

4.4.3 Triangle Amplitude Adjustment

1. Use a type W or 1A5 plug-in module with the scope for this calibration. Connect the oscilloscope probe (X1) to output of the triangle amplifier at TP2 and ground at TP1 on the main board. Make sure the frequency setting is at 9.99 X 100 Hz.

2. Adjust the positive peak of the triangle to +1.25 V \pm 5 mV using R21 on the main board.
3. Adjust the negative peak of the triangle to -1.25 V \pm 5 mV using R11 on the main board.

4.4.4 Frequency Calibration

1. Set function to \sqcap and connect the main output to the scope.
2. Set frequency to 0.09 X 0.1M. Alternately short and open VCG IN to ground and adjust R34 on the D/A amplifier board until no frequency shifting can be observed on the scope.
3. Connect the main output to a counter and verify that the shifting is less than 100 Hz.
4. Set frequency to 0.01 X 10K. Adjust R29 on the D/A amplifier board for 100 Hz \pm 15 Hz. (VCG should not be shorted to ground.)
5. Connect the output to an oscilloscope. Adjust the time symmetry to within 1% using R7 on the VCG board. A dual channel counter set in the B-A mode may also be used for this calibration. By alternately changing the slopes from positive to negative on both channels, the asymmetry may be measured.
6. Set frequency to 9.99 X 10 kHz. Adjust output frequency to 99.9 kHz \pm 100 Hz using R40 on D/A amplifier board.
7. Set frequency to 8.99 X 1 MHz. Adjust frequency to 8.99 MHz \pm 25 kHz using C4 on main board. Trim C2 if necessary.
8. Set frequency to 9.99 X 10K. Re-adjust frequency to 99.9 kHz \pm 100 Hz using R40 on D/A amplifier board. Trim R31 on D/A amplifier board if necessary.
9. Set frequency to 0.01 X 10 kHz. Re-adjust output frequency to 100 Hz \pm 15 Hz using R29 on D/A amplifier board.
10. Check frequency accuracy from 1.00 X 1M to 9.99 X 1M. All frequencies should be within \pm 2.0% of full scale. If not, re-adjust C4. If adjusting C4 does not help, try to trim capacitors C16, C17, C22 and C23 on the main board. Add 5 to 10 pF capacitance at locations C16 and C23, if frequency at the 9.99 X 1 MHz setting is too low. Reduce 5 to 10 pF of capacitance at both C17 and C22, if frequency at the 9.99 X 1 MHz setting is too high.

11. Set frequency to 9.99 X 0.1M. Adjust frequency to 999 kHz \pm 1 kHz using C6 on the main board. Trim C8 if necessary.
12. Set frequency to 9.99 X 1K. Adjust output frequency to 9.99 kHz \pm 10 Hz using R39 on D/A amplifier board.
13. Set frequency to 9.99 X 100. Adjust output frequency to 999 Hz \pm 1 Hz (or period to 1001 μ s \pm 1 μ s) using R38 on the D/A amplifier board.
14. Set frequency to 9.99 X 10. Adjust output frequency to 99.9 Hz \pm 0.1 Hz (or period to 10.01 ms \pm 10 μ s) using R37 on the D/A amplifier board.
15. Connect a scope probe to the output of the triangle amplifier at TP2 and ground at TP1 on the main board.
16. Set generator to TRIG mode with front panel switch. Set frequency to 9.99 X 10 Hz. Adjust the dc level to 0 Vdc \pm 3 mV using R2 on the main board.
17. Set generator back to continuous running, frequency to 0.50 X 1.0 Hz, and function to \square . Adjust the time symmetry at the 50 Ω OUT connector to less than 0.2% using R47 on the VCG board. In addition to using sweep magnifier on scope for this calibration, a dual channel counter may be used as described in Step 5 of Section 4.4.4.
18. Set frequency to 9.99 X 1.0 Hz. Adjust output frequency to 9.99 Hz \pm 0.01 Hz (or period to 100.1 ms \pm 0.1 ms) using R15 on the VCG board.

4.4.5 X-Y Multiplier Adjustment

1. Set function to DC, frequency to 2.00 X 100 Hz, and DC/OFFSET to 0 0.00.
2. Make sure the 50 Ω output ground is not shorted to program ground by measuring the voltage between the two grounds; i.e., the grounds of 50 Ω OUT and TRIG IN.
3. Connect the 50 Ω OUT to an oscilloscope. Alternately short and open the 50 Ω ground to the TRIG IN ground. Adjust R153 on the main board at the same time until the dc level at the output changes less than 5 mV.

NOTE

In case the voltage across the two grounds is too small and the effect is not obvious, an external voltage less than 10 Vdc can be applied momentarily between the two grounds for the above calibration. R153 should be adjusted for a dc shift of less than 5 mV.

4. Adjust R117 on the main board so that the output dc level stays within 10 mV at the 0.00 and 9.00 settings of the P-P AMPLITUDE VOLTS control.
5. Set DC/OFFSET to 0 Vdc \pm 20 mV using R132 on the main board.
6. Set function to \wedge (frequency remains at 2.00 X 100 Hz) and P-P AMPLITUDE to 0.00.
7. Adjust the voltage between TP3 and TP1 (GND) on main board to 0 Vdc \pm 5 mV using R8 on the D/A amplifier board. TP3 is located at one end of R110 in the X-Y multiplier section on the main board.
8. Adjust the 50 Ω OUT signal to minimum using R118 on the main board.
9. Set P-P AMPLITUDE to 0.05 V. Adjust R124 on main board for the most linear waveform.
10. Reset P-P AMPLITUDE to 0.00. Repeat Step 8.
11. Set function to DC with P-P AMPLITUDE and DC/OFFSET still at 0.00. Adjust dc voltage at 50 Ω OUT to 0 Vdc \pm 20 mV into open circuit using R132 on the main board.
12. Set function to \wedge and P-P AMPLITUDE to 0.00. Repeat Step 8.

4.4.6 Sine Distortion Adjustment

1. Set function to \smile , frequency to 9.99 X 100 Hz, and P-P AMPLITUDE to 9.99.
2. Connect a scope probe (X1) to the output of the sine amplifier at TP4 and ground at TP1. Connect the other end to a low frequency sine distortion analyzer.
3. Adjust sine distortion for minimum using R85, R86 and R88 on the main board. These pots interact so several adjustments of each pot may be necessary for minimum distortion.

4. Adjust for minimum sine distortion at 50Ω OUT using R120 on the main board.
5. Check sine distortion at 9.99 X 1 kHz. Re-adjust R85, R86 and R88, if necessary, to obtain optimum sine distortion at 999 Hz and 9.99 kHz.
6. Set function to DC, frequency to 2.00 X 100 Hz and DC/OFFSET to 0 0.00. Repeat Steps 4 and 11 in Section 4.4.5 (X-Y Multiplier Adjustment).

4.4.7 Output Amplitude and DC Offset Adjustment

1. Set function to DC and P-P AMPLITUDE to 0.00. Adjust R18 on the D/A amplifier board so that the dc level at the 50Ω OUT connector changes less than 10 mV at different dc polarity settings: “-”, “0” and “+”.
2. Set P-P AMPLITUDE to 9.99 V, function to \sphericalangle and frequency to 9.99 X 100 Hz.
3. Adjust output amplitude to 9.99 V p-p ± 10 mV into a precision 50Ω load using R10 on the D/A amplifier board.

Set function to \sim . Adjust the amplitude to 9.99 V p-p ± 10 mV using R108 on the main board.
5. Adjust the dc offset of \sim output to less than ± 10 mV using R93 on the main board.
6. Set function to \sqcap . Adjust the peak voltage to ± 4.995 V ± 5 mV using R57 and R54 on the main board for positive and negative peaks, respectively.

NOTE

If calibration cannot be achieved, trim R44 (on main board) so that the \sqcap signal at the emitter of Q13 is symmetrical about ground within 200 mV.

7. Set function to DC and DC/OFFSET VOLTS to +9.99. Adjust the output voltage at 50Ω OUT connector to +9.99 V ± 10 mV using R22 on the D/A amplifier board without a load.
8. Switch DC/OFFSET VOLTS to -9.99. The output voltage should be -9.99 V ± 60 mV. If not, re-adjust R22 to obtain optimum calibration.
9. Set function to \sim , P-P AMPLITUDE to 0.00 and DC/OFFSET VOLTS to +4.99.

10. Adjust the dc offset at the 50Ω OUT connector to +4.99 V ± 5 mV into a precision 50Ω load using R24 on the D/A amplifier board.
11. Switch the DC/OFFSET VOLTS to -4.99. The output voltage should be -4.99 V ± 30 mV. If not, re-adjust R24 to obtain optimum calibration.

4.4.8 High Frequency Amplitude Response Adjustment

1. Set frequency to 1.00 X 1 MHz, DC/OFFSET to 0 0.00, P-P AMPLITUDE to 9.99 V, and function to \sqcap . Make sure that the output is loaded with a precision 50Ω load.
2. Adjust C75 and C77 on the main board for best looking square waveform.
3. Set function to \sim . Adjust for best amplitude flatness to 10 MHz with 1 kHz as reference using C49 on the main board.

4.4.9 Trigger Baseline Adjustment

1. Set function to \sphericalangle , frequency to 9.99 X 100 Hz, DC/OFFSET to 0 0.00, and P-P AMPLITUDE to 9.99 V. Generator should be in TRIG mode. Adjust output voltage to 0 Vdc ± 10 mV using R2 on the main board.
2. Change frequency to 0.01 X 100 Hz. Adjust output voltage to 0 Vdc ± 30 mV using R34 on the VCG board.
3. Change function to \sim . Adjust output voltage to 0 Vdc ± 10 mV using R93 on the main board.

4.5 CORRECTIVE MAINTENANCE

This portion of the manual presents a systematic approach to trouble-shooting. It is composed of two parts. Part one (see 4.5.1) is a quick guide for locating the area of the problem. Part two (see 4.5.2) contains 12 tables which are given as detailed supplements to part one.

The following abbreviations are used:

Symbol	Meaning
B	Base (transistor)
C	Collector (transistor)
E	Emitter (transistor)
G	Gate (FET)
S	Source (FET)
D	Drain (FET)
CR	Diode
Qn	Transistor number (n)
V _{GS}	Voltage between gate and source (FET)
Q	Output terminal (flip-flop)
\bar{Q}	Inverting output terminal (flip-flop)

4.5.1 Quick Trouble-Shooting Guide

Symptom	Corrective Action
Blown Line Fuse	<p>Replace fuse. If it blows again, check the following:</p> <ol style="list-style-type: none"> 1. Solder bridge or wire connection shorted. 2. Q45 and/or Q46 shorted in output amplifier. 3. One of the 7 transistors mounted on the rear panel is shorted to itself or to another transistor through the chassis. 4. Follow Table 4-2 to locate the short in a particular supply. 5. By-pass capacitors for power supply are shorted. 6. Relay in -24 V supply is shorted.
+15 V Power Supply Malfunctions	<ol style="list-style-type: none"> 1. Voltage low: <ol style="list-style-type: none"> a. Transformer output low. b. Extra current loading. Check for overheated and defective component in the circuit. c. Q2 or Q3 is shorted. d. Q1 is open. e. CR2 is shorted. f. IC1 is defective. 2. Voltage high: <ol style="list-style-type: none"> a. Power transistor TIP29 or Q1 is shorted. b. Q3 is open. c. IC1 is defective. 3. High frequency oscillation (MHz): <ol style="list-style-type: none"> a. C4 or C5 at IC1 is defective. b. One of the semiconductors in another part of the circuit is oscillating. Locate by using hand to touch the most sensitive area of the circuit boards. 4. Large 60 cycle noise: <ol style="list-style-type: none"> a. Dirty contact. Unplug the power board and clean the contact. b. Defective filter capacitor, C1 or C9.
Other Power Supply Malfunctions	<ol style="list-style-type: none"> 1. Follow Table 4-2 to locate the problem to a particular power supply. 2. Use similar procedure for trouble-shooting as in the +15 V power supply malfunctions.
No Output Signals	<ol style="list-style-type: none"> 1. If no \sphericalangle signal is present at output of \sphericalangle AMPL, follow Table 4-3 for trouble-shooting. 2. If no signal is present at pin 4 of IC2 in the X-Y multiplier on main board, follow Table 4-7 to check out relay logic. 3. If no signal is present at both emitters of Q31 and Q32 with the \sphericalangle function selected, follow Table 4-12 to check out the X-Y multiplier. 4. If signal is seen at emitter of Q31 and Q32, follow Table 4-5 to check out the output amplifier.
No \sphericalangle , \square or SYNC Output	Follow Table 4-12 to check out the corresponding circuit.
\square Rise/Fall Time Abnormally Slow	<ol style="list-style-type: none"> 1. Malfunctioning \square amplifier. 2. One of the capacitors in the output amplifier is open. 3. C75 and C77 (output amplifier) are not calibrated. 4. C50, C53 or C52 in X-Y multiplier is open.

Quick Trouble-Shooting Guide (continued)

Symptom	Corrective Action
Frequency Accuracy Out of Specification	<ol style="list-style-type: none"> 1. Check frequency calibration. 2. Check for defective C10, C16 to C23, CR18 and/or CR20 on main board, if problem is in X10K to X1 MHz ranges. 3. Check capacitance multiplier, if problem appears in X0.001 to X1 ranges only, using Table 4-6. 4. Check digit switch, D/A converter of frequency section, if problem appears to be in frequency setting, using Table 4-9. 5. Check VCG and D/A amplifier for frequency linearity problem in all ranges, using Table 4-4. 6. Follow Table 4-10 for frequency ranging problem.
High Frequency Output Has Abnormal Ringing	<ol style="list-style-type: none"> 1. C69 or output amplifier is open. 2. Defective capacitor in output amplifier.
High Sine Distortion at Low Frequency	<ol style="list-style-type: none"> 1. \wedge amplitude and time symmetry calibration is off. 2. Defective sine converter. 3. Sine converter or X-Y multiplier calibration is off. 4. Dirty contact on power supply board.
High Sine Distortion at High Frequency	<ol style="list-style-type: none"> 1. \sqcap also looks bad, if problem is in the output amplifier. 2. Defective capacitors C10 and C16 to C23 in \wedge amplifier. 3. Defective C29 to C36 in sine amplifier. 4. Defective sine converter.
Unsymmetrical \wedge	Follow Table 4-4 to check out the VCG circuit.
Amplitude Accuracy Out of Specification	<ol style="list-style-type: none"> 1. Check calibration. 2. Check for defective C25, C31 and C67 for frequency linearity problem over 1 kHz. 3. Check digit switch and D/A converter for amplitude setting problem, using Table 4-9. 4. Follow Table 4-8 for amplitude ranging problem. 5. Check X-Y multiplier, using Table 4-12.
DC Offset Accuracy Out of Specification	<ol style="list-style-type: none"> 1. Check calibration. 2. Check digit switch and D/A converter for offset setting problem, using Table 4-9. 3. Check for zero offset of X-Y multiplier and output amplifier.
TRIG and GATED Mode Inoperative	<ol style="list-style-type: none"> 1. Check trigger and gated control switches. 2. Check for correct signals in the trigger circuit, using Table 4-11.

4.5.2 Trouble-Shooting Guide Tables

one or two seconds at a time to prevent it from blowing fuses and further damage circuit components.

4.5.2.1 POWER SUPPLIES

Use Table 4-2 to localize the problem to a particular power supply and associated loading circuitry. In some cases, it is necessary to turn on the power of the unit no more than

NOTE

Be sure to use the correct ground in the following voltage checks.

Table 4-2. POWER SUPPLIES

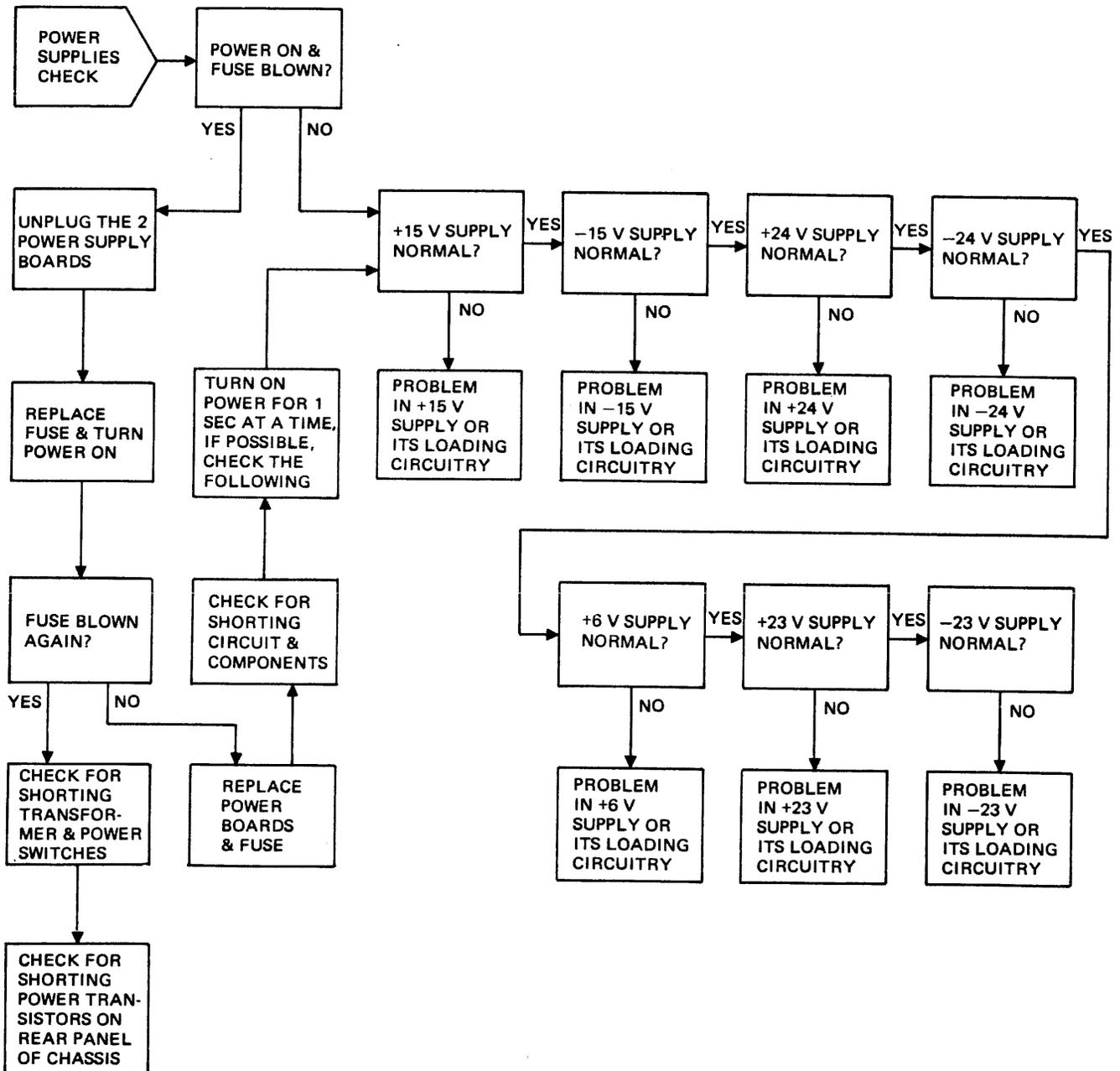


Table 4-3. TRIANGLE AMPLIFIER, COMPARATOR, AND HYSTERESIS SWITCH

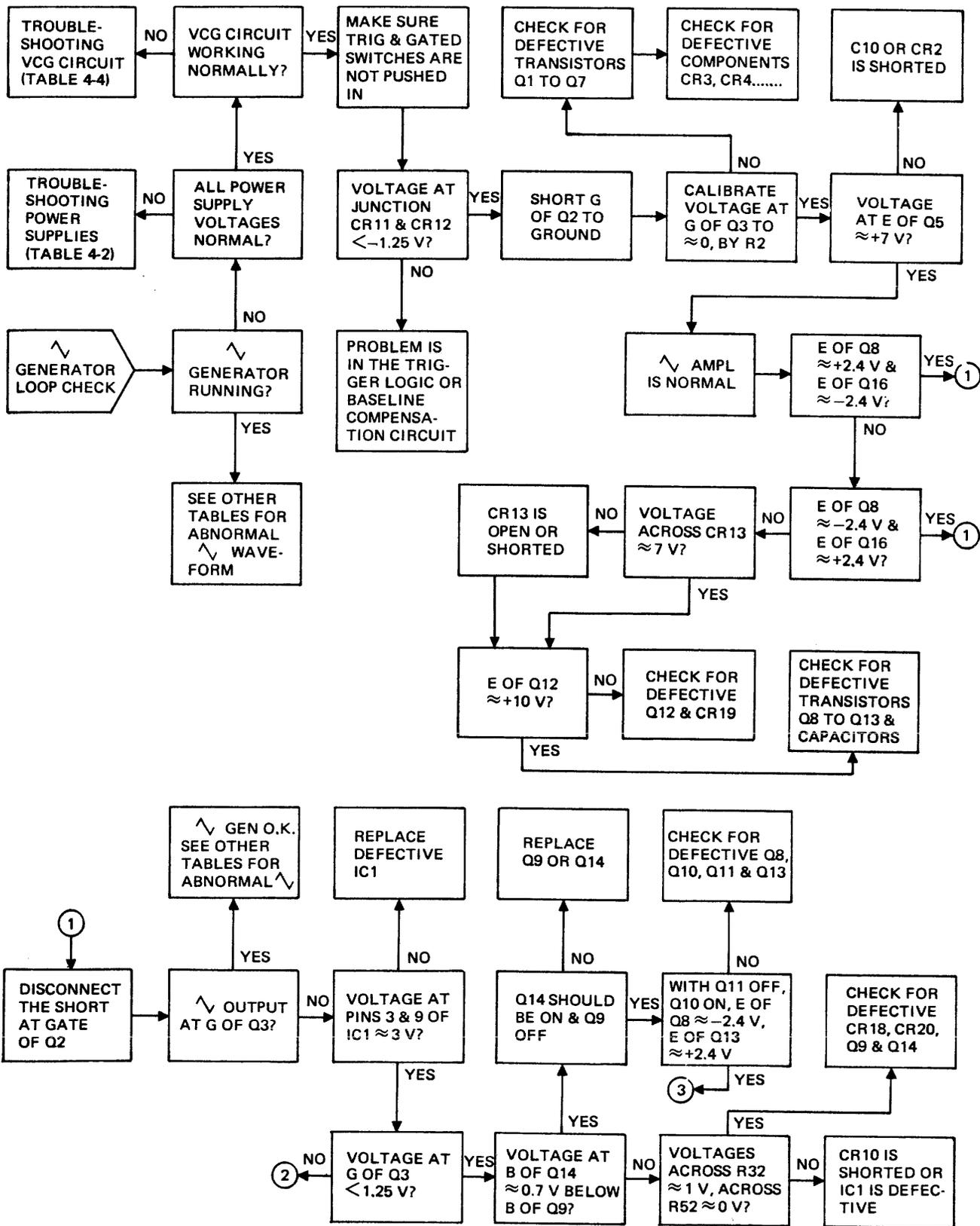


Table 4-3. TRIANGLE AMPLIFIER, COMPARATOR, AND HYSTERESIS SWITCH (Continued)

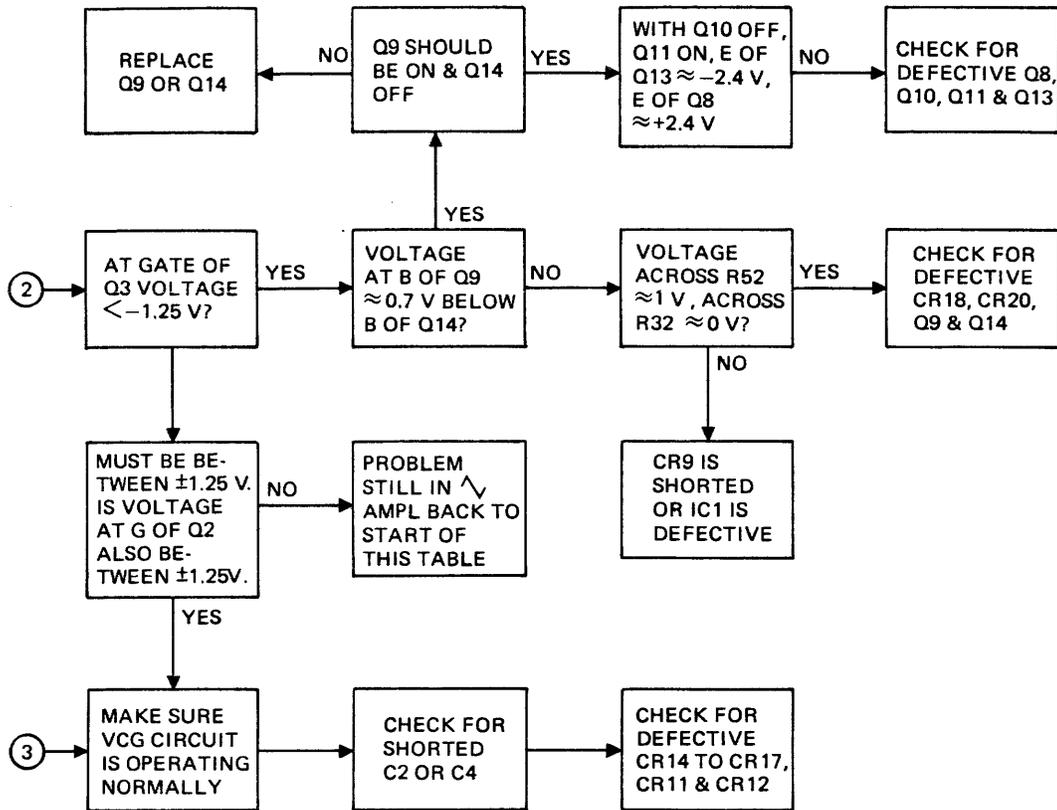


Table 4-4. VCG AND CURRENT SOURCE

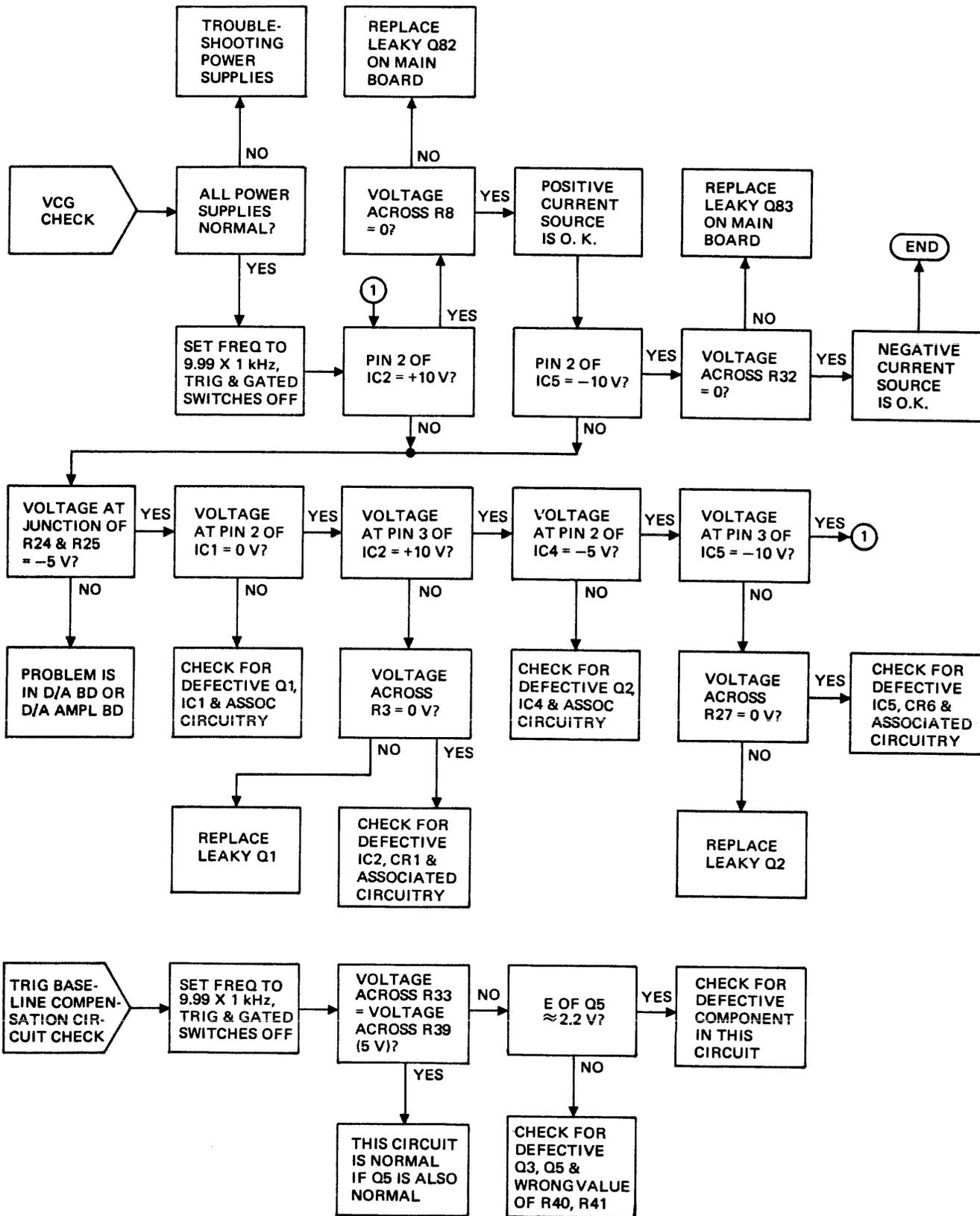


Table 4-5. OUTPUT AMPLIFIER

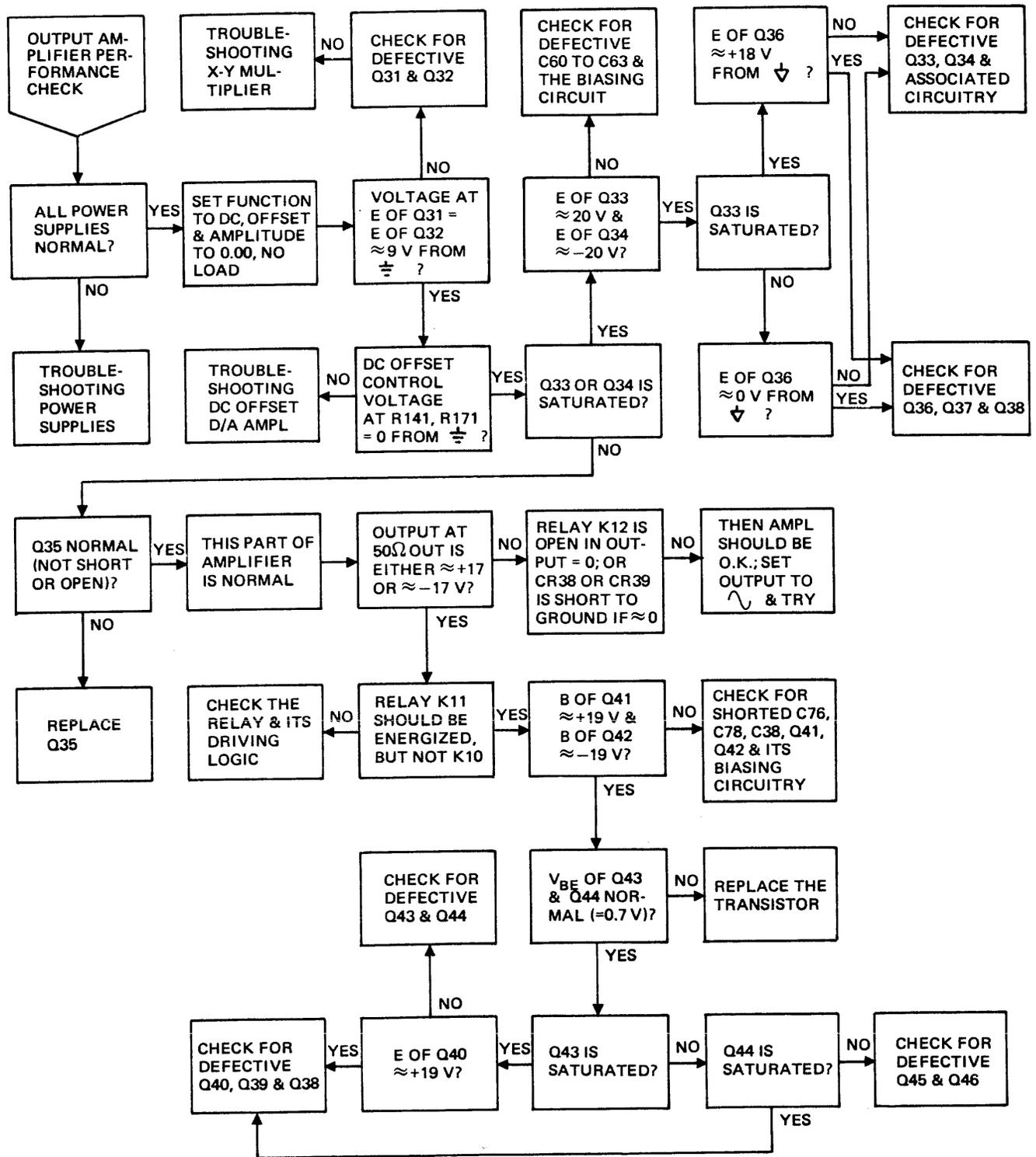


Table 4-6. CAPACITANCE MULTIPLIER

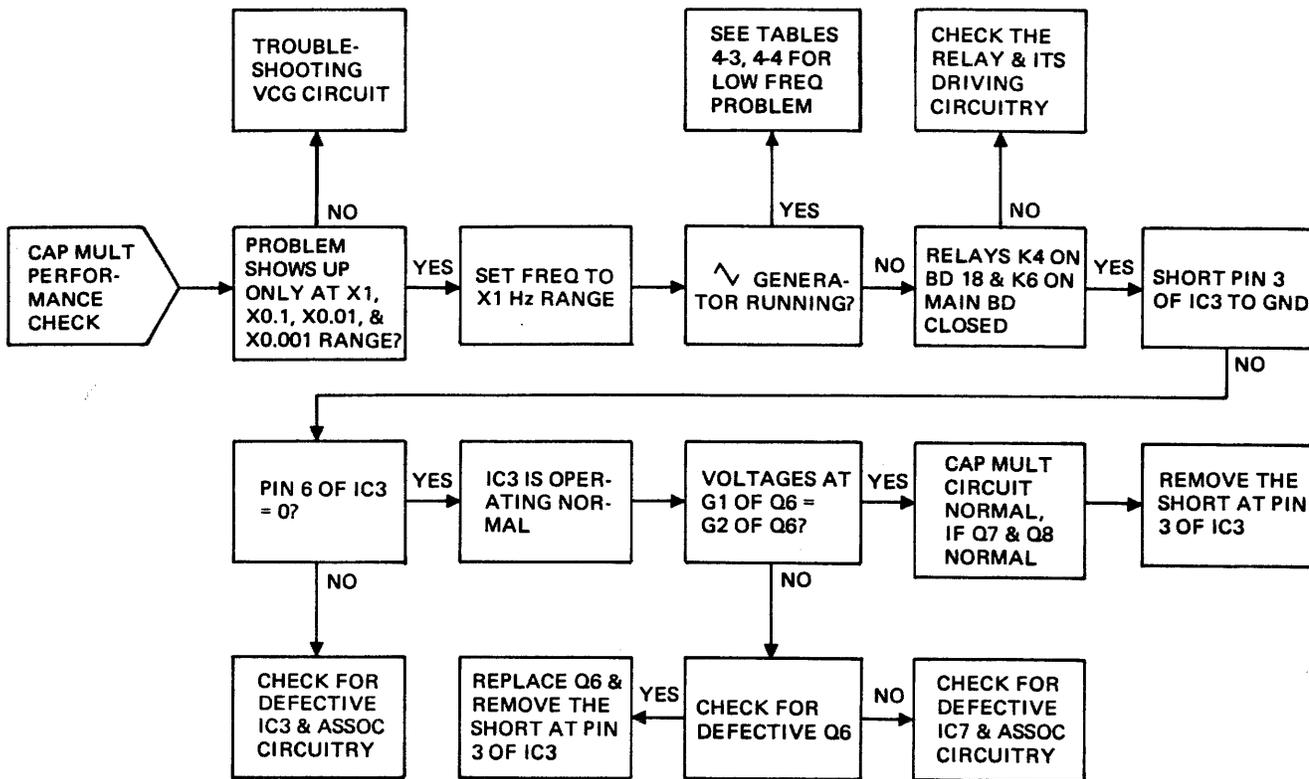


Table 4-7. FUNCTION LOGIC

COMPONENTS FUNCTION	Q58	Q59	Q60	Q61	Q62	Q63	Q64	K7	K8	K9
	~	X		X						
∧	X			X	X			X		
⌋		X		X		X			X	X
DC (Also see Table 4-8)		X	X				X			X

- NOTES: 1. For standard logic only. For inverse logic, interchange Q58 with Q59 and Q60 with Q61.
 2. For TRIG and GATED logic, see Timing Diagram, Table 4-11.
 3. The transistor or relay with "X" is in an "ON" state.

4.5.2.2 AMPLITUDE RANGING CONTROL LOGIC

Table 4-8 is provided as a hint for trouble-shooting amplitude ranging control logic.

1. At X0.1 range, only Q48,Q49,Q51,Q56 and K13 are "ON" and all other transistors and relays should be "OFF".
2. Relay K12 should never be "ON" when K13, K14 or K15 is "ON".

Table 4-8. AMPLITUDE RANGING CONTROL LOGIC

COMPONENTS AMPL RANGE	ALL COMPONENTS ARE ON MAIN CIRCUIT BOARD										
	STANDARD LOGIC ONLY, FOR INVERSE LOGIC, INTERCHANGE Q47 WITH Q48 AND Q49 WITH Q50				RELAY OR LOGIC DRIVER (ON)	(K1, D/A AMPL BOARD) K10	K11	K12	K13	K14	K15
	Q47	Q48	Q49	Q50							
X1		X		X	Q54 Q55		X	X			
X0.1		X	X		Q51 Q56				X		
X0.01	X			X	Q52 Q56					X	
X0.001	X		X		Q53 Q56						X
DC output (Also see Table 4-7)	Not Applicable		Not Applicable		Q57 Q55	X	X	X			

NOTE: The transistor or relay with "X" is in an "ON" state.

4.5.2.3 D/A CONVERTER

The D/A converter can easily be checked out by comparing the voltage level at the cathode of each switching diode according to Table 4-9. If the voltage level is not in agreement

with the table, check for correct voltage at the connector and the associated circuitry.

Pin No. 1 at the connector is the summing node of the D/A amplifier and should be 0 Vdc. If not, the problem is in the D/A amplifier.

Table 4-9. D/A CONVERTER

COMPONENTS FREQ AMPL OR OFFSET SETTINGS	PIN NUMBER AT CONNECTOR D/A CONVERTER BOARD												DIODE (CR) NUMBER (VOLTAGE AT CATHODE)											
	3	4	5	6	7	8	9	11	12	13	14	15	40	37	34	30	27	24	21	17	14	11	8	4
0.00	0	0	0	0	0	0	0	0	0	0	0	0	L	L	L	L	L	L	L	L	L	L	L	L
1.11	1	0	0	0	1	0	0	0	1	0	0	0	H	L	L	L	H	L	L	L	H	L	L	L
2.22	0	1	0	0	0	1	0	0	0	1	0	0	L	H	L	L	L	H	L	L	L	H	L	L
3.33	1	1	0	0	1	1	0	0	1	1	0	0	H	H	L	L	H	H	L	L	H	H	L	L
4.44	0	0	1	0	0	0	1	0	0	0	1	0	L	L	H	L	L	L	H	L	L	L	H	L
5.55	1	0	1	0	1	0	1	0	1	0	1	0	H	L	H	L	H	L	H	L	H	L	H	L
6.66	0	1	1	0	0	1	1	0	0	1	1	0	L	H	H	L	L	H	H	L	L	H	H	L
7.77	1	1	1	0	1	1	1	0	1	1	1	0	H	H	H	L	H	H	H	L	H	H	H	L
8.88	0	0	0	1	0	0	0	1	0	0	0	1	L	L	H	H	L	L	H	H	L	L	H	H
9.99	1	0	0	1	1	0	0	1	1	0	0	1	H	L	H	H	H	L	H	H	H	L	H	H

NOTE: H = +6 V.

L = 0 V.

1 is > 2.4 V for standard logic, < 1 V for inverting logic.

0 is < 1 V for standard logic, > 2.4 V for inverting logic.

4.5.2.4 FREQUENCY RANGING LOGIC

Table 4-10 is provided as a hint for trouble-shooting frequency ranging and calibration problems. A few typical examples are listed below to clarify the use of this table.

1. Defective Q16, C12, K3, R39 or K6 will cause abnormal frequency output at X1K range. Shorted C3 will have 0 Vdc output. Inoperative K4 will have frequency output as at X1 MHz range, etc.

2. Frequency stays the same at all ranges from X0.001 to X10 Hz, if relay K6 is not energized or is open.
3. Frequency out of specification at X10K, X0.1M and X1M ranges indicates that R40 is not properly calibrated.
4. Each pair of transistors, Q1 and Q2, Q3 and Q4, Q5 and Q6, and Q7 and Q8, should never be "ON" or "OFF" simultaneously. If this occurs, all frequency ranging is wrong, or there is no ranging control at all.

Table 4-10. FREQUENCY RANGING LOGIC

COMPONENTS FREQ RANGING	TRANSISTORS ON FREQ RANGING BOARD (See Note 1)						MAIN BD						VCG BD			D/A AMPL BD								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	RELAY OR LOGIC DRIVER (ON)	C6 C7 C8		C11 C12 C13		C14 CAP C15 MULT		R20 R22 R16 R21 R23 R17			R37 R38 R39 R40					
										K1	K2	K3	K4	K5	K6	K2	K3	K4	K4	K5	K6	K7		
X0.001	X		X		X		X		Q9, Q21 Q13, Q14					X	X					X				
X0.01		X	X		X		X		Q10, Q21 Q13, Q14					X	X		X			X				
X0.1	X			X	X		X		Q11, Q21 Q13, Q14					X	X			X		X				
X1		X		X	X		X		Q12, Q21 Q13, Q14					X	X				X		X			
X10	X		X			X	X		Q14					X						X				
X100		X	X			X	X		Q15				X								X			
X1K	X			X		X	X		Q16			X										X		
X10K		X		X		X	X		Q17, Q18 Q20		X													X
X0.1M	X		X		X		X		Q18, Q19 Q20		X													X
X1M		X	X		X		X		Q18, Q20															X

NOTES: 1. For standard control logic only (for inverse logic, interchange each pair of transistors).
2. The transistor or relay with "X" is in its "ON" state.

4.5.2.5 TRIGGER AND GATED LOGIC TIMING

For trouble-shooting the trigger, set the generator at GATED mode. Refer to Table 4-11. Draw a vertical line on the timing diagram along t₁ or t₂, depending on whether the

TRIG IN signal is low or high, and check for correct voltage levels according to the timing diagram.

After the GATED mode has been checked out and is working normally, the TRIG mode can be checked in the same way but concentrated in the Q78, Q77 area.

Table 4-11. TRIGGER AND GATED LOGIC TIMING DIAGRAM

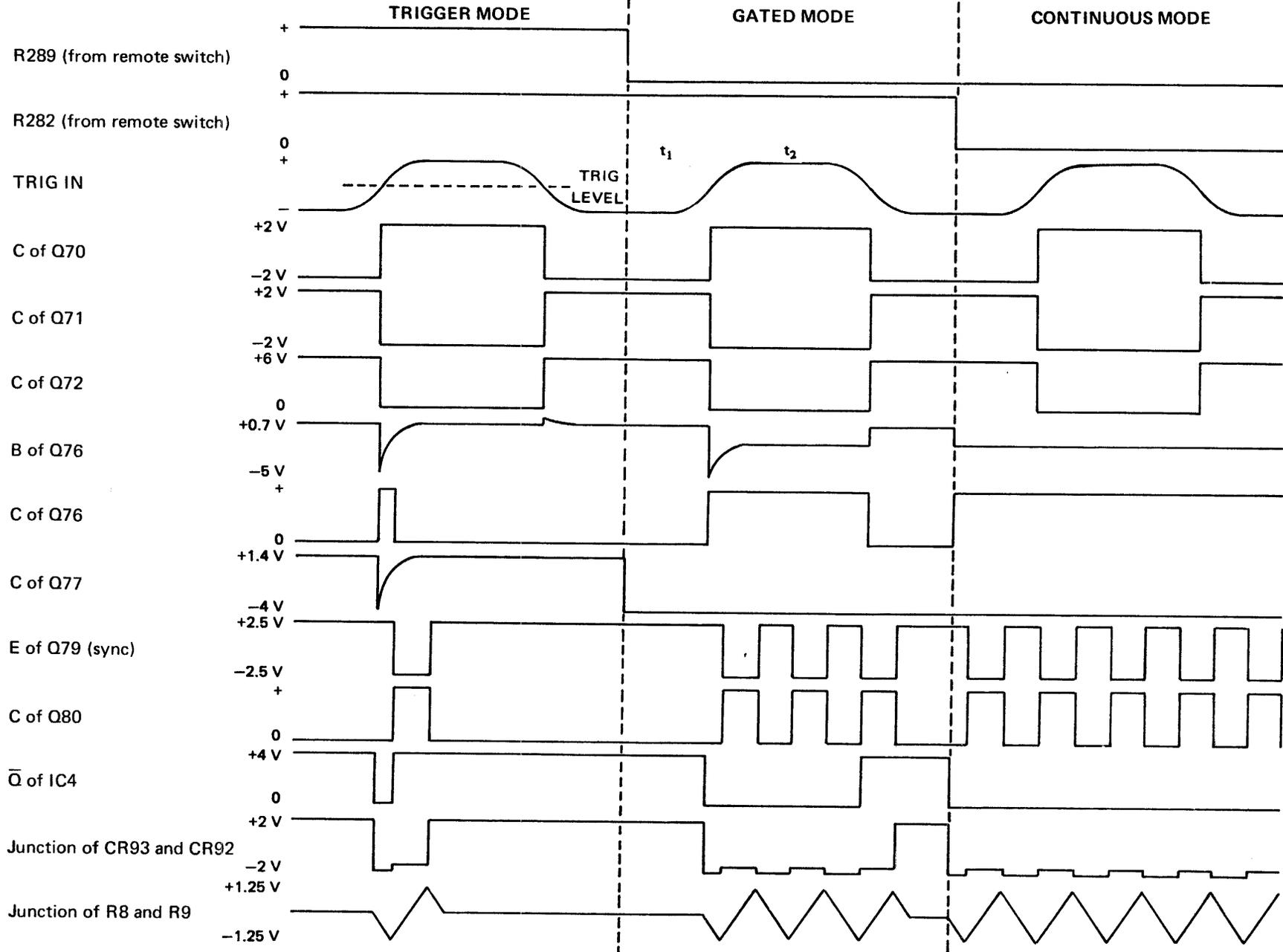


Table 4-12. KEY SIGNAL AND VOLTAGE

~ AMPLIFIER, COMPARATOR AND HYSTERESIS SWITCH

Test Point	Typical Voltage
G of Q2	2.5 V p-p  , 0 Vdc offset
G of Q3	2.5 V p-p  , 0 Vdc offset
E of Q5	2.5 V p-p  , ≈ +7 Vdc offset
Pins 1 and 4 of IC1	See Table 4-13
Pins 2 and 8	-3 V
Pins 3 and 9	-3.7 V
E of Q14	+6.8 Vdc
B of Q14 and Q9	See Table 4-13
E of Q8 and Q13	See Table 4-13
E of Q12	+10 V
R42 and R45 junction	-3 V
S of Q82	+10 V to +15 V, dependent on frequency setting
S of Q83	-10 V to -15 V, dependent on frequency setting

X-Y MULTIPLIER

Test Point	Typical Voltage
R111	Selected signal ( ,  ,  or DC)
R110	VCA input, voltage dependent on amplitude setting
Pins 8 and 12 of IC2	0 Vdc
Pin 5 of IC2	Same signal as at pin 4, but -1.4 V offset
Pins 6 and 11 of IC2	-1.4 V
Pin 10 of IC2	-1.4 V below pin 9
Pins 3 and 13	-13.5 V
Pin 1 of IC2	+5 V
E of Q32	Selected signal output, +9 Vdc offset, amplitude dependent on setting
E of Q31	Inverted output of Q32

~ CONVERTER AND AMPLIFIER

Test Point	Typical Voltage
Pin 2 of A1	See Table 4-13
Pin 4 of A1	+14 V
Pin 1 of A1	-14 V
Pin 5 of A1	250 mV p-p  , 0 Vdc offset
R75 and R76 junction	2.5 V p-p  , 0 Vdc offset
B of Q17 and Q18	+8 V

OUTPUT AMPLIFIER

Test Point	Typical Voltage
Voltage between  and 	-1 to +1 V (when floating)
E of Q33	+19 Vdc
E of Q34	-19 Vdc
R157 and R158 junction	+0.7 Vdc
E of Q35	Selected waveform, 0 to 1 V p-p
E of Q36	+10 V ±5 V
B of Q41	+19 Vdc
E of Q43	+19 Vdc
B of Q42	-19 Vdc
E of Q44	-19 Vdc
R166 and R168 junction	+0.7 Vdc
E of Q37 and Q39	+19 Vdc
E of Q40	+2 V to +18 V
R192 and R193 junction	Main output, ±15 V maximum

SYNC AND SQUARE AMPLIFIER

Test Point	Typical Voltage
R84 and R56 junction	±2.4 V 
CR27 cathode	±1.25 V 
R95 and R96 junction	±1.25 V 

AUX AMPLIFIER

Test Point	Typical Voltage
E of Q26	0 to +6 V 
E of Q27	+3.5 V
C of Q29	0 to +6 V  , < 5 ns RF time

D/A AMPLIFIER

Pins 2 and 3 of all D/A amplifiers (IC1, IC2 and IC3) are 0 Vdc. Their output voltages are dependent on front panel and remote control settings. The gain of IC2 will decrease to 1/2 when dc output is selected and K1 is closed.

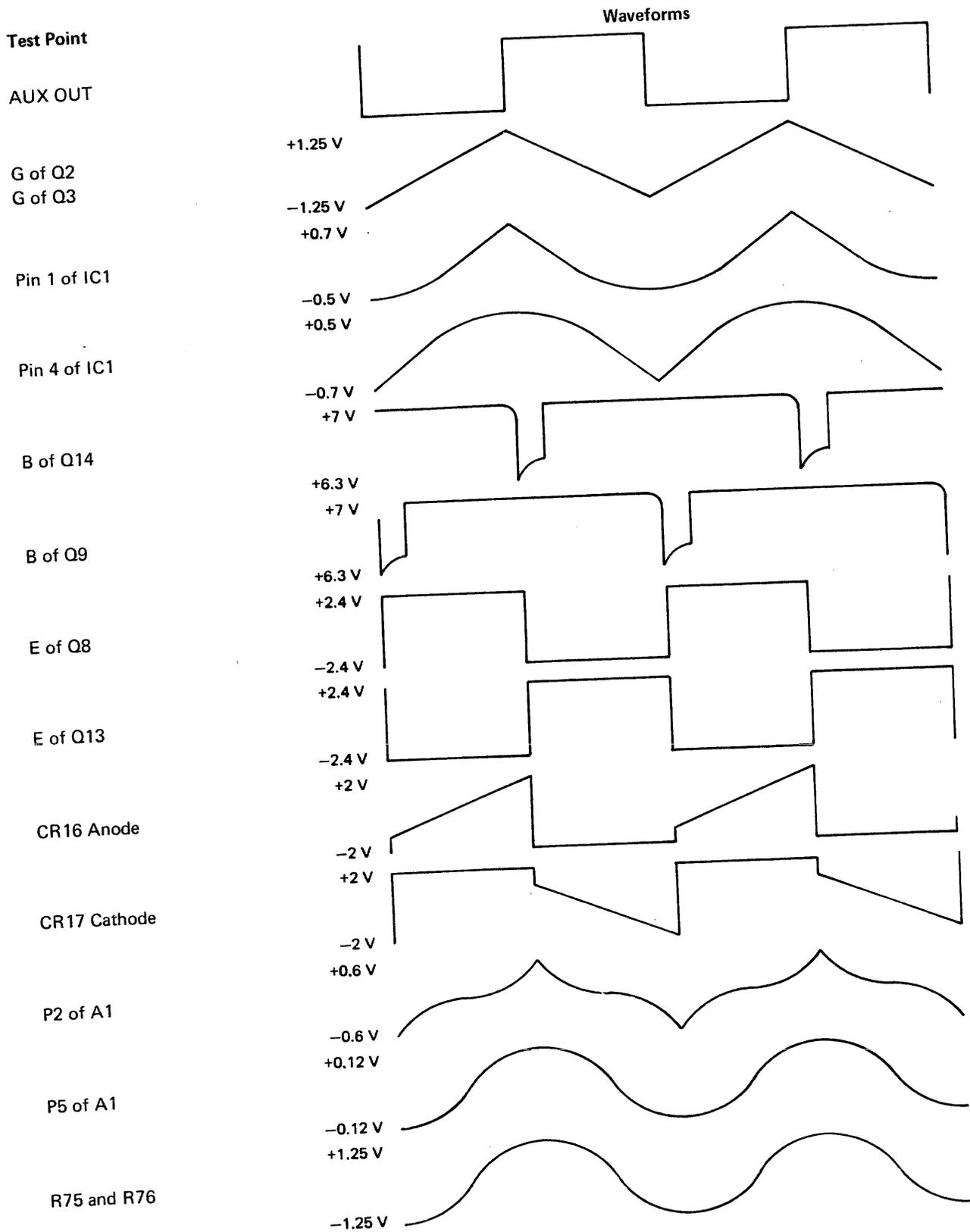
Table 4-12. KEY SIGNAL AND VOLTAGE (Continued)

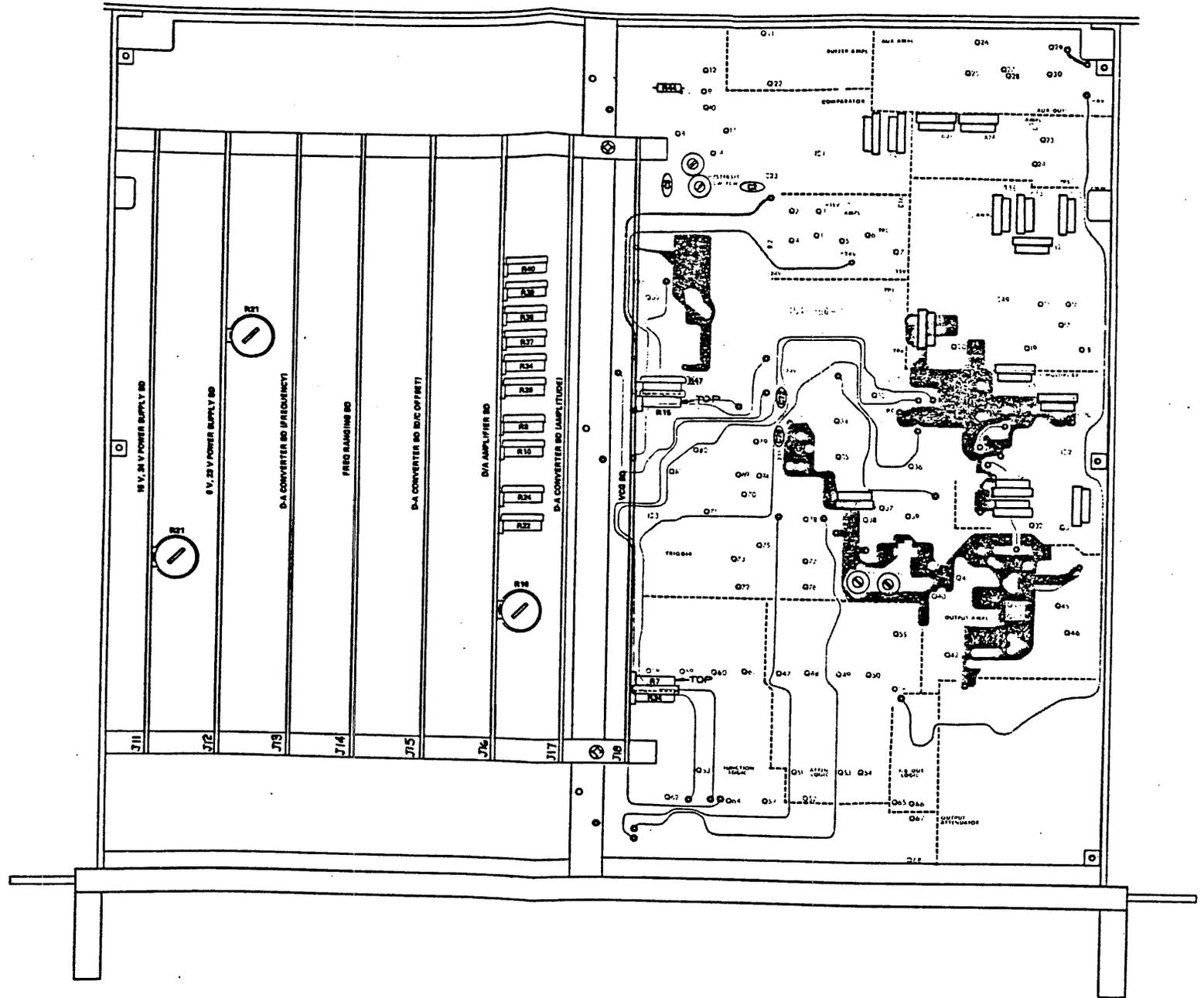
VCG AMPLIFIER AND TRIGGER BASELINE COMPENSATION		CAPACITANCE MULTIPLIER*	
Test Point	Typical Voltage	Test Point	Typical Voltage
R24 and R25 junction	0 to -5 V*	G1 and G2 of Q6	± 1.25 V \wedge
S of Q1	0 V	Pin 6 of IC7	\square , amplitude dependent on frequency setting
Pins 2 and 3 of IC2	+15 to +10 V*	Pins 2 and 3 of IC3	± 1.25 V \wedge
S of Q2	0 to -5 V*	Pin 6 of IC3	± 7.50 V \wedge
Pins 2 and 3 of IC5	-15 to -10 V*		
V_{GS} of Q3	$V_{G1,S1} = V_{G2,S2}$		
R36 and R37	Voltage across both are equal		
E of Q5	+2.2 V		
R36	Voltage across R39 and R29 are equal		

*The above information applies if the frequency range is at X1 Hz.

*Voltage is dependent on a frequency setting of 0.00 to 9.99.

Table 4-13. KEY WAVEFORMS





ADJUSTMENT AND TEST POINT LOCATIONS

SECTION 5

DIAGRAMS, ADDENDA AND PARTS LISTS

5.1 DRAWINGS

The following assembly drawings (with parts lists) and schematics are in the arrangement shown below.

5.2 ORDERING PARTS

When ordering spare parts, please specify part number, circuit reference, board, serial number of unit and, if applicable, the function performed.

5.3 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

CROSS REFERENCE FOR DRAWING NUMBERS

Drawings	Old Number	New Number	Drawings	Old Number	New Number
Chassis Schematic	154-200	0004-00-0041	D-A Converter Schematic	154-213	0103-00-0083
Chassis Assy	154-000	0002-00-0300	D-A Converter Assy	154-013	0101-00-0083
Chassis Parts List	*	1101-00-0041	D-A Converter Parts List	*	1100-00-0083
Main Board Schematic	154-215	0103-00-0085	Frequency Range Schematic	154-212	0103-00-0082
Main Board Assy	154-015	0101-00-0085	Frequency Range Assy	154-012	0101-00-0082
Main Board Parts List	*	1100-00-0085	Frequency Range Parts List	*	1100-00-0082
Patch Block Assy	154-024	1205-00-0489	D-A Amplifier Schematic	154-214	0103-00-0084
Patch Block Parts List	*	*	D-A Amplifier Assy	154-014	0101-00-0084
Mother Board Assy	154-010	0101-00-0080	D-A Amplifier Parts List	*	1100-00-0084
Mother Board Parts List	*	1100-00-0080	VCG Board Schematic	154-216	0103-00-0086
15V, 24V Power Supply Schematic	154-211	0103-00-0081	VCG Board Assy	154-016	0101-00-0086
15V, 24V Power Supply Assy	154-011	0101-00-0081	VCG Board Parts List	*	1100-00-0086
15V, 24V Power Supply Parts List	*	1101-00-0081	Transistor Mounting Board Assy	154-017	0101-00-0087
6V, 23V Power Supply Schematic	154-221	0103-00-0089	Transistor Mounting Board Parts List	*	1100-00-0087
6V, 23V Power Supply Assy	154-021	0101-00-0089	Rear Panel Assy	154-001	0102-00-0331
6V, 23V Power Supply Parts List	*	1100-00-0089	Rear Panel Parts List	*	1101-00-0072
			Extender Board Assy	154-018	0101-00-0088
			Extender Board Parts List	*	1100-00-0088

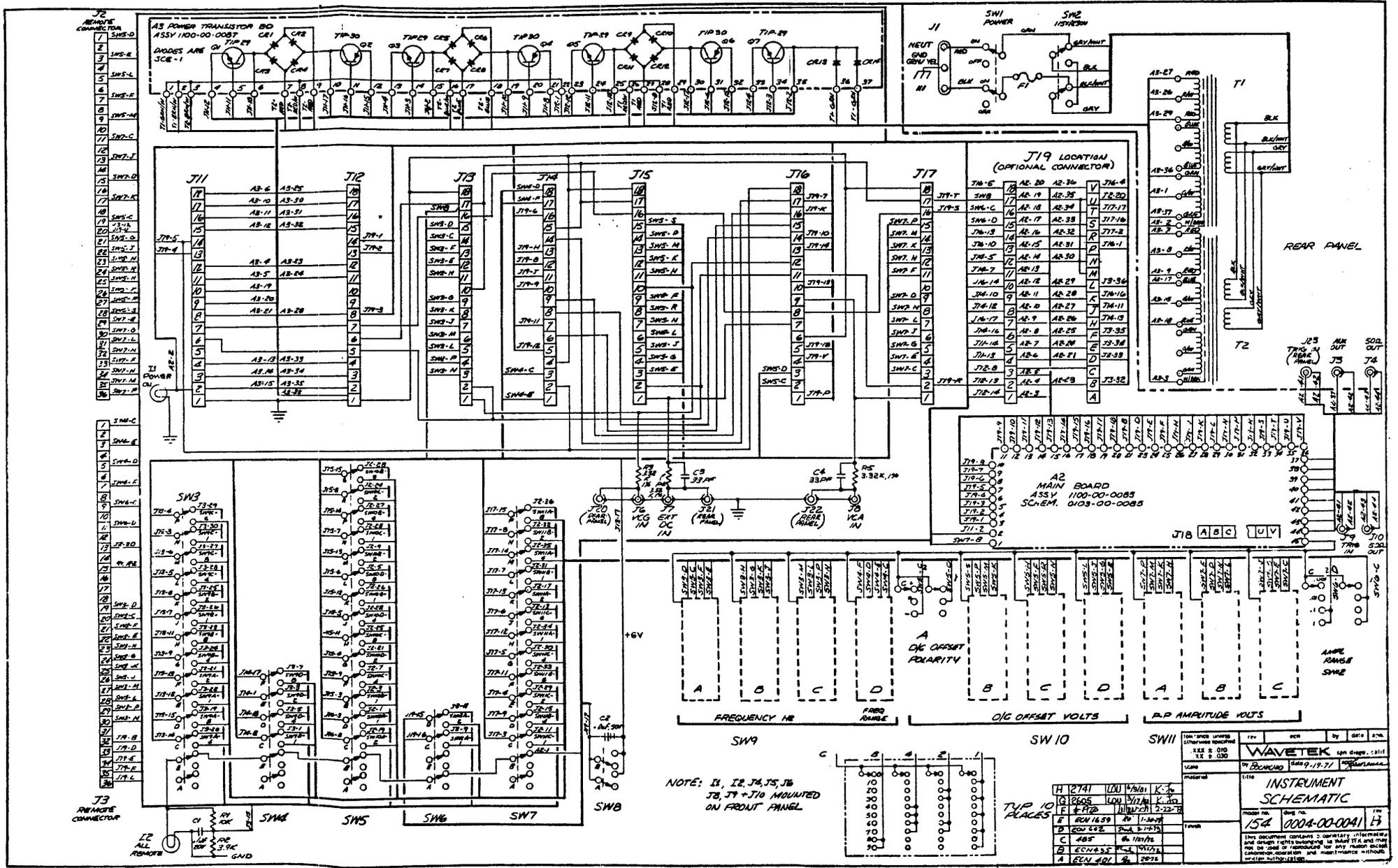
*Same as assembly number

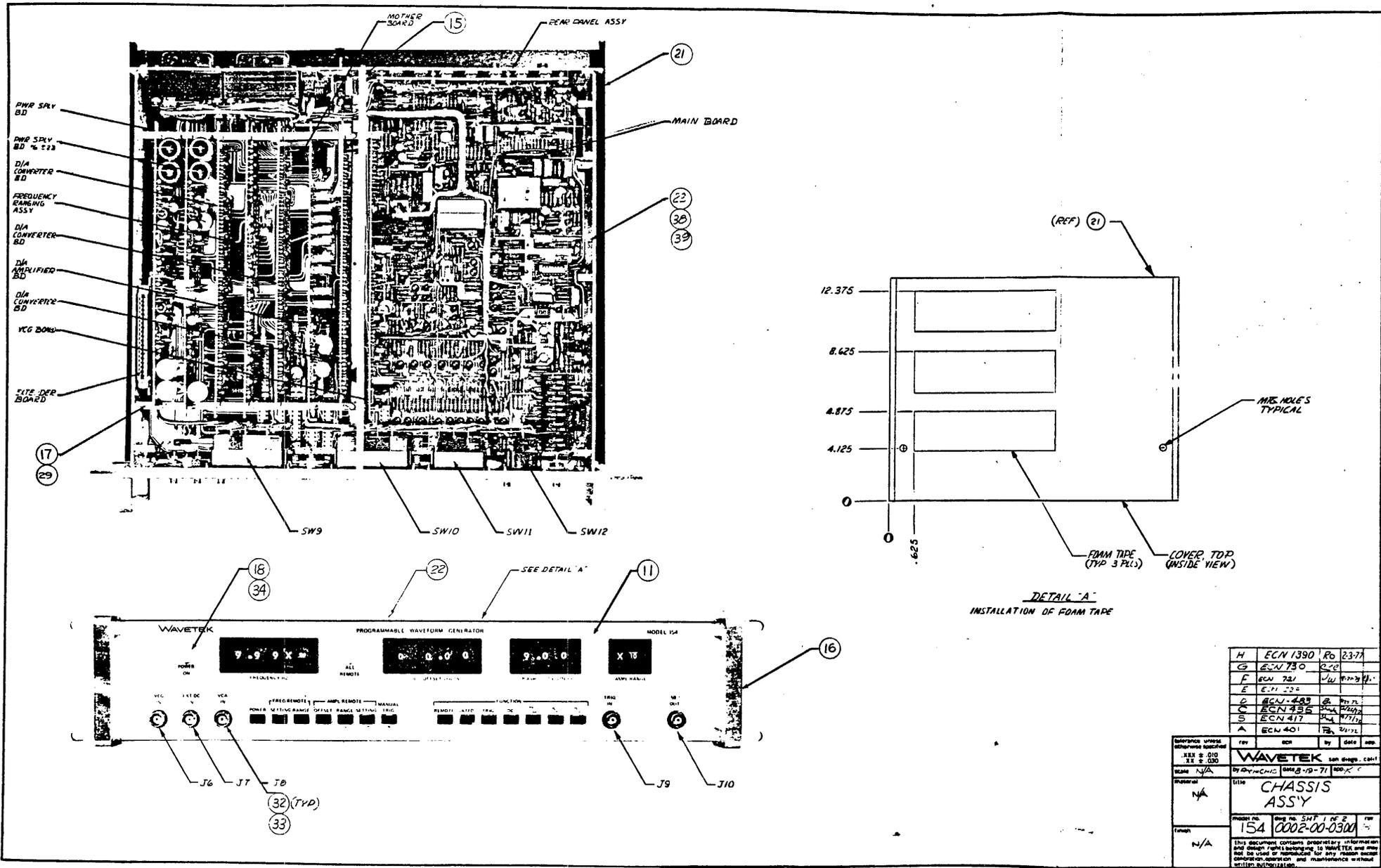
5.4 RECOMMENDED SPARE PARTS LIST

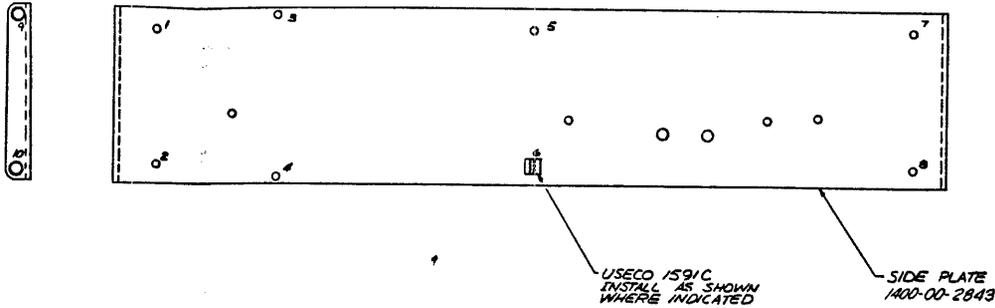
Information is provided to maintain the instrument on a board or component level. Price and delivery information should be obtained from the Wavetek representative in your area or directly from the factory.

DESCRIPTION	MFG	PART NO.	QTY
BOARD LEVEL			
15 V, 24 V POWER SUPPLY BOARD	WAVETEK	154-011	1
FREQ RANGING BOARD	WAVETEK	154-012	1
D/A CONVERTER BOARD	WAVETEK	154-013	1
D/A AMPLIFIER BOARD	WAVETEK	154-014	1
VCG BOARD	WAVETEK	154-016	1
6 V, 23 V POWER SUPPLY BOARD	WAVETEK	154-021	1
COMPONENT LEVEL			
DIODE TUNNEL	GE	1N3716	1
DIODE	SEMTECH	SCE-1	2
DIODE	FAIRCHILD	FD777	1
DIODE	FAIRCHILD	FD6666	8
*DIODE -69	FAIRCHILD	FD6666	2
DIODE ZENER	WAVETEK	130-506	2
FUSE 1/4 115 V	LITTELFUSE	313-500	
FUSE 1/4 230 V	LITTELFUSE	313-250	1
*INTEGRATED CKT -13	FAIRCHILD	μA709C	2
*INTEGRATED CKT -14	FAIRCHILD	μA709C	2
INTEGRATED CKT	RCA	CA3028A	1
INTEGRATED CKT	RCA	CA3049	1
INTEGRATED CKT	MOTOROLA	MC1595L	1
INTEGRATED CKT	MOTOROLA	MC3050P	1
LAMP	MURA	BP 28/40	2
RELAY	JENCO	RR30-1023	2
RELAY	JENCO	RR30-1024	2
SINE MODULE	WAVETEK	B142-011	1
TRANSISTORS	FAIRCHILD	2N3638	8
TRANSISTORS	FAIRCHILD	2N3642	2
TRANSISTORS	FAIRCHILD	2N3646	8
TRANSISTORS	FAIRCHILD	2N4248	2
TRANSISTORS	MOTOROLA	MPS L08	1
TRANSISTORS	MOTOROLA	2N2905A	1
*TRANSISTORS -52	MOTOROLA	2N3563	2
*TRANSISTORS -53	MOTOROLA	2N5485	2
*TRANSISTORS -54	MOTOROLA	2N5485	1
*TRANSISTORS -55	MOTOROLA	2N5462	1
*TRANSISTORS -66	MOTOROLA	2N2219A	2
TRANSISTORS	TEXAS INST	TIP 29	2
TRANSISTORS	TEXAS INST	TIP 30	2
TRANSISTORS	TECH PROD	TP 308	1

* Denotes special selected parts and should be ordered from Wavetek.







NO.	LEFT	RIGHT
1	X	
2		X
3	X	X
4	X	X
5	X	
6		X
7	X	
8		X
9	INSTALL BOOTS	
10	FASTENERS	
	T8DD100	
	LEFT & RIGHT	

X INDICATES INSTALL BLOCK

1 LEFT REQD/UNIT
1 RIGHT

SEE SHEET 1			
REV	BY	DATE	APP
A	ECN 401	4/1/77	
tolerance unless otherwise specified .XXX ± .010 .XX ± .030			
scale	FULL WAVE TEK 1150 BOCHKING (REV 2-11-77) 100K 5E		
material	N/A 1150 CHASSIS ASSEMBLY LEFT + RIGHT SIDE PLATES		
model no.	154 0002-00-0300 H		
part no.	154 0002-00-0300 H		
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REV	ECN	BY	DATE	APP
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-#FOR-PART-NO	#FOR	WAVETEK NO.	QTY/PY
NONE	ASSY DRWG. CHASSIS	0102-00-0300	WVTK	0102-00-0300	1
22	SUB PANEL ASSY	134-004	WVTK	1201-00-0020	1
29	SPACER	144-305	WVTK	1400-00-2113	2
11	PANEL, FT	134-300	WVTK	1400-00-2810	1
23	RAIL, SIDE	134-303	WVTK	1400-00-2843	2
14	BAR, SUPT	134-304	WVTK	1400-00-2853	1
15	BAR, SUPT, TOP	134-305	WVTK	1400-00-2863	1
17	GUIDE, SD	134-310	WVTK	1400-00-2880	2
18	LENS, INDICATOR	134-311	WVTK	1400-00-2890	2
21	COVER	134-319	WVTK	1400-00-2923	2
16	HANDLE REF: 3200-04-0001	134-320	WVTK	1400-00-2923	2
NONE	SHIELD, INSULATOR REF: 3200-03-0004	134-324	WVTK	1400-00-3360	1
NONE	ID LABEL SPECIAL INSTRUMENT	1400-01-0990	WVTK	1400-01-0990	1
J10 J6 J7 J8 J9	BNC CONN	KC-7946	KING	2100-01-0002	5
NONE	CONN	57-30260	AMPH	2100-02-0028	2
31	SOLDER LUG	1497	SMITH	2100-04-0012	5

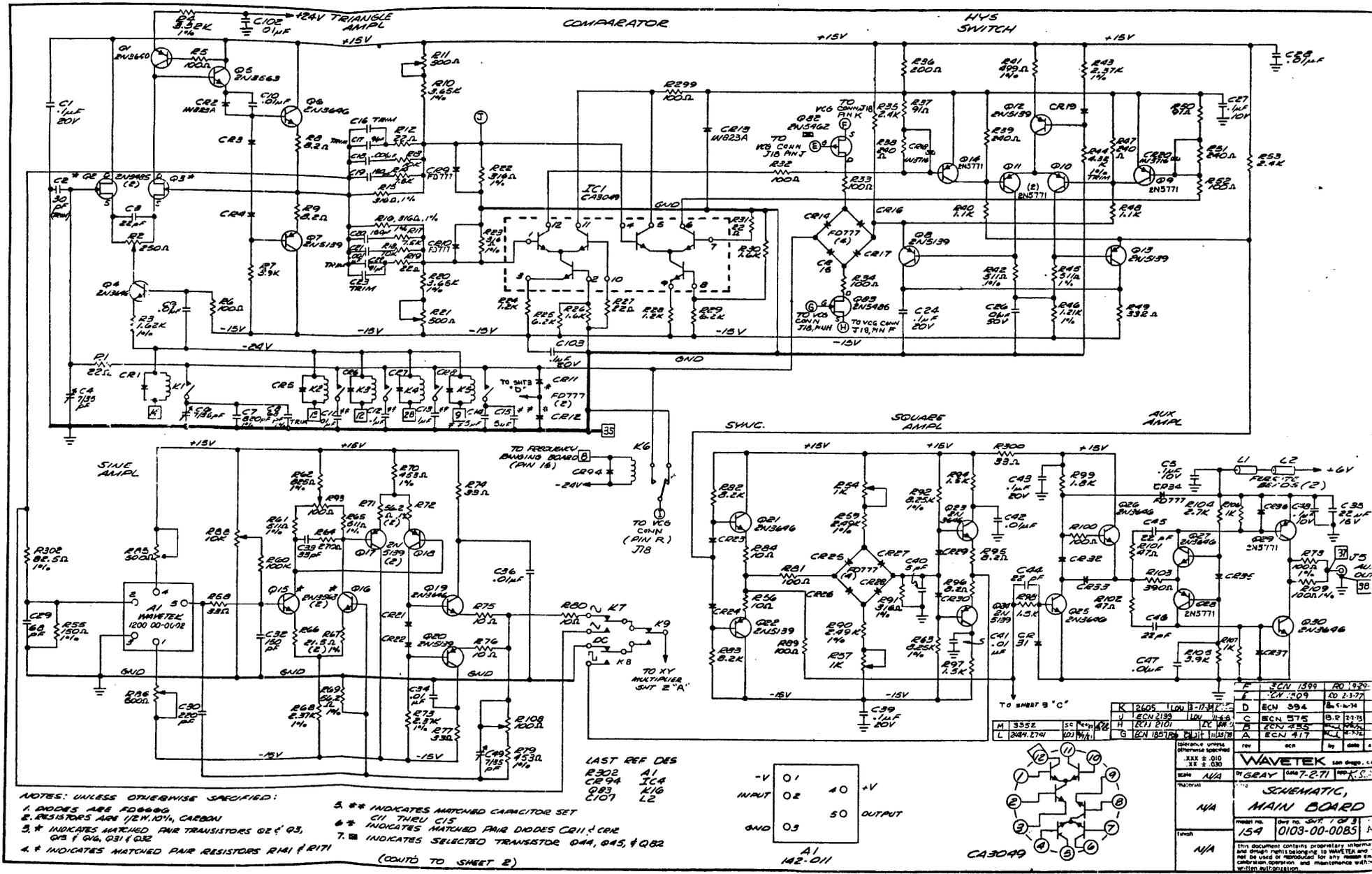
WAVETEK PARTS LIST TITLE: STD CHASSIS ASSEMBLY NO. 1101-00-0041 REV. K
PAGE: 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-#FOR-PART-NO	#FOR	WAVETEK NO.	QTY/PY
46	INSERT, BANG. LOC	T810100-632	BOOTS	2800-09-0017	4
41	FAST. CHASSIS	1591-C11	USECO	2800-09-0022	10
43	WASHER, SHOULDER	2661	SMITH	2800-27-0002	2
32	WASHER, SHOULDER	2668	SMITH	2800-27-0004	5
33	NYLON FLAT WASHER	2264-N-385	AMTCH	2800-28-0005	5
34	PETAINING RING	3305-31	TRUMC	2800-28-0002	2
SW1	SWITCH ASSY DIO1	134-400	WVTK	3107-00-0001	1
SW10	SWITCH ASSY DIO1	134-401	WVTK	3107-00-0001	1
SW11	SWITCH ASSY DIO1	134-402	WVTK	3107-00-0003	1
SW12	SWITCH ASSY DIO1	134-403	WVTK	3107-00-0004	1
NONE	PHR CORD	6001-80-0005	WVTK	6001-80-0005	1

WAVETEK PARTS LIST TITLE: STD CHASSIS ASSEMBLY NO. 1101-00-0041 REV. K
PAGE: 2

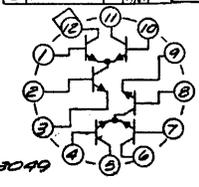
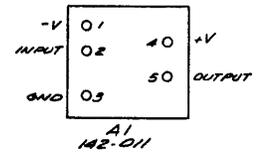
NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DESIGN	DATE	WAVETEK LAS VEGAS • CALIFORNIA
MATERIAL	PROJ/ENGR	TITLE	
	RELEASE APPROV		PARTS LIST CHASSIS
	TOLERANCE UNLESS OTHERWISE SPECIFIED FRACTIONS ANGLES 15°		
FINISH WAVETEK PROCESS	DO NOT SCALE DIMS	SCALE	
	SCALE		
	FORM NO. 154	FORM NO. 1101-00-0041	REV. K
	CODE 2333B	SHEET 1	OF 1



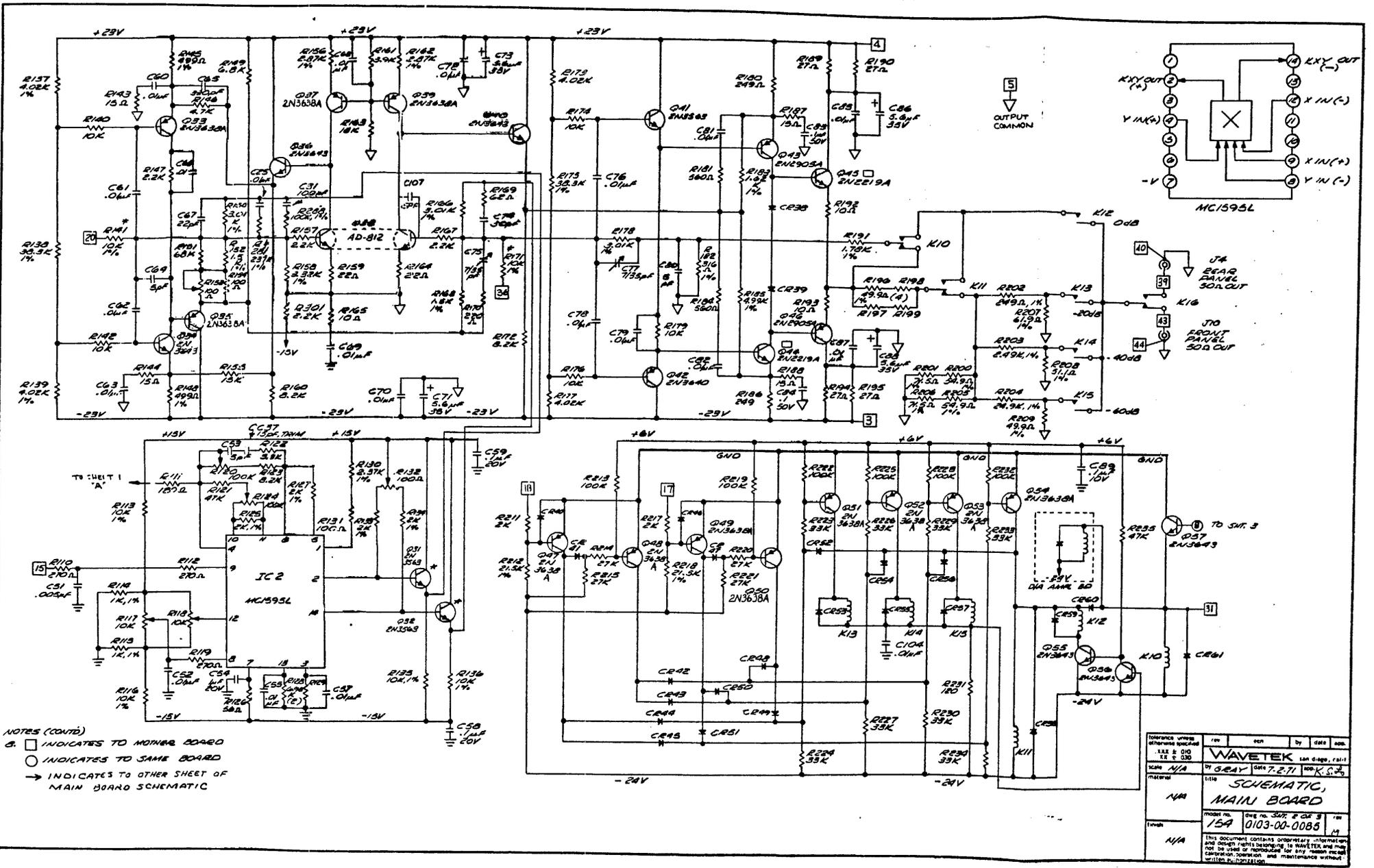
NOTES: UNLESS OTHERWISE SPECIFIED:
 1. DIODES ARE FD3000
 2. RESISTORS ARE 1/2W, 10%, CARBON
 3. * INDICATES MATCHED PAIR TRANSISTORS Q2 & Q3, Q5 & Q6, Q31 & Q32
 4. * INDICATES MATCHED PAIR RESISTORS R141 & R171
 5. ** INDICATES MATCHED CAPACITOR SET C11 THRU C15
 6. * INDICATES MATCHED PAIR DIODES CR11 & CR2
 7. * INDICATES SELECTED TRANSISTOR Q44, Q45, & Q82
 (CONT'D TO SHEET 2)

LAST REF DES
 R302 A1
 CR94 IC4
 Q83 L16
 C101 L2



M	3352	SC	100	100	100	100	100	100	100
L	3404, 2740	100	100	100	100	100	100	100	100

WAVETEK
 MODEL 154
 SERIAL 0103-00-0085
 DATE 1-77
 REVISION 1



NOTES (CONT'D)
 □ INDICATES TO MOTHER BOARD
 ○ INDICATES TO SAME BOARD
 → INDICATES TO OTHER SHEET OF MAIN BOARD SCHEMATIC

Drawn	Checked	Rev	By	Date	Appr
WAVETEK	WAVETEK	1	WAVETEK	1984	
SCALE: N/A	BY: 82AY	DATE: 7.27.84	BOOK: G-2		
TITLE: SCHEMATIC, MAIN BOARD					
MODEL NO. 15A	REV. NO. 300	OF 3			
15A	0103-00-0085				

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REV ECR BY DATE

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REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PY
NDNE	ASBY DRWG. MAIN	0101-00-0085	WVTK	0101-00-0085	1
NDNE	SCHEMATIC. MAIN	0103-00-0085	WVTK	0103-00-0085	1
A1	SINE MOD	142-011	WVTK	1200-00-0002	1
1C4	PATCH BLOCK	194-024	WVTK	1203-00-0489	1
C107	CAP. CER. 22PF. 1KV	DD-030 LONG LEAD	CRL	1500-00-3001	1
C40 C53 C64 C80 C93	CAP. CER. 30PF. 1KV	DD-090	CRL	1500-00-3011	3
C94	CAP. CER. 100PF. 1KV	DD-100	CRL	1500-01-0011	1
C31	CAP. CER. 100PF. 1KV	DD-101	CRL	1500-01-0111	1
C18 C21	CAP. CER. .001MF. 1KV	DD-102	CRL	1500-01-0211	2
C10 C102 C104 C25 C26 C28 C34 C36 C41 C42 C47 C52 C55 C57 C40 C61 C62 C83 C66 C68 C69 C70 C72 C76 C78 C79 C81 C82 C85 C87 C9 C91 C95	CAP. CER. 1MF. 50V	CAC023U1032100A	CORND	1500-01-0310	33
C1 C103 C105 C106 C24 C27 C29 C43 C48 C5 C54 C58 C59 C83 C84 C89	CAP. CER. 1MF. 50V	CAC023U1042090A	CORND	1500-01-0405	14
C37	CAP. CER. 13PF. 1KV	DD-130	CRL	1500-01-3011	1
C32	CAP. CER. 130PF. 1KV	DD-131	CRL	1500-01-3111	1

WAVETEK PARTS LIST

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REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PY
C4 C49 C6 C75 C77 C35 C98	VARI. 7-35PF. 250V	78-TR10D-02 7/35 PF	TRIAD	1500-53-3000	5
C71 C73 C86 C88 C90	CAP. TANT. 22PF. 15V	194022A19015KA1	BFRAG	1500-72-2401	2
195	CAP. TANT. 5.6MF. 35V	1500545319032B2	BFRAG	1500-75-4302	5
197	MAIN	154-119	WVTK	1700-00-0085	1
J18	BKT. IC. 14PIN	C0814-01.	TI	2100-03-0011	1
NONE	CONN. EDGE CARD	252-18-30-160	CINCH	2100-03-0013	1
NONE	HEAT SINK	200	MAKE	2800-11-0001	2
NONE	TRANSIPAD	10160	HETRO	2800-11-0004	2
198	HEATSIK MNT	1103A	THERM	2800-11-0005	2
199	HEATSIK BODY	1103B	THERM	2800-11-0006	2
L1 L2	FERRITE BEAD	34-590-45/28	FERRI	3100-00-0001	2
R1 R12 R13 R14 R15 R2 K3 R4 R5	RELAY. REED. FORM-A	FB-844	PHIPP	4500-00-0004	9
R10 R11 R16 R6 R7 R8 R9	RELAY. REED. FORM-C	FB-845	PHIPP	4500-00-0005	7
R108 R132 R133 R93	POT. TRIM. 100	Y1AR100	BECK	4600-01-0103	4
R54 R57	POT. TRIM. 1K	Y1AR1K	BECK	4600-01-0209	2
R117 R118 R89	POT. TRIM. 10K	Y1AR10K	BECK	4600-01-0315	3

WAVETEK PARTS LIST

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REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PY
R24 R28 R46	RES. HF. 1/8W. 1%. 1.21K	RN550-1211F	TRM	4701-03-1211	3
R111 R231	RES. HF. 1/8W. 1%. 124	RN550-1240F	TRM	4701-03-1240	2
R55	RES. HF. 1/8W. 1%. 15K	RN550-1500F	TRM	4701-03-1500	1
R132 R148 R273 R285 R295 R94 R97 R98	RES. HF. 1/8W. 1%. 1.5K	RN550-1501F	TRM	4701-03-1501	8
R143 R144 R187 R189	RES. HF. 1/8W. 1%. 15K	RN550-1502F	TRM	4701-03-1502	4
R155 R293 R294 R297	RES. HF. 1/8W. 1%. 15	RN550-1505F	TRM	4701-03-1505	4
R182 R26 R3 R30	RES. HF. 1/8W. 1%. 1.62K	RN550-1621F	TRM	4701-03-1621	4
R191 R99	RES. HF. 1/8W. 1%. 1.78K	RN550-1781F	TRM	4701-03-1781	2
R163	RES. HF. 1/8W. 1%. 18.2K	RN550-1822F	TRM	4701-03-1822	1
R133 R137 R132 R134 R211 R217 R238 R244 R259	RES. HF. 1/8W. 1%. 2K	RN550-2001F	TRM	4701-03-2001	9
R212 R218 R239 R245 R246 R247	RES. HF. 1/8W. 1%. 21.2K	RN550-2122F	TRM	4701-03-2122	4
R1 R12 R139 R164 R19 R27 R31 R94 R97	RES. HF. 1/8W. 1%. 21.5	RN550-21A5F	TRM	4701-03-2129	9
R170	RES. HF. 1/8W. 1%. 221	RN550-2210F	TRM	4701-03-2210	1
R147 R157 R167 R243 R244 R279 R292 R301	RES. HF. 1/8W. 1%. 2.21K	RN550-2211F	TRM	4701-03-2211	8

WAVETEK PARTS LIST

TITLE MAIN

ASSEMBLY NO. 1100-00-0085

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REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PY
C101 C3 C44 C45 C46 C47 C86 C99	CAP. CER. 22PF. 1KV	DD-220	CRL	1500-02-2011	8
C30	CAP. CER. 220PF. 1KV	DD-221	CRL	1500-02-2111	1
C74	CAP. CER. 30PF. 1KV	DD-300	CRL	1500-03-0001	1
C33	CAP. CER. 30PF. 1KV	DD-330	CRL	1500-03-3011	1
C63	CAP. CER. 330PF. 1KV	DD-331	CRL	1500-03-3111	1
C97	CAP. CER. 47PF. 1KV	DD-470	CRL	1500-04-7011	1
C81	CAP. CER. .003MF. 50V	CR-502	CRL	1500-05-0210	1
C29	CAP. CER. .68PF. 1KV	DD-680	CRL	1500-06-8001	1
C19 C20	CAP. NICA. 150PF. 500V	DN15-151J	ARCO	1500-11-1510	2
C27	CAP. NICA. 30PF. 500V	DN15-300J	ARCO	1500-12-0000	1
C87	CAP. NICA. .68PF. 500V	DN15-680F	ARCO	1500-16-8001	1
C7	CAP. NICA. 820PF. 300V	DN15-821F	ARCO	1500-18-2101	1
C17 C22	CAP. NICA. 91PF. 500V	DN15-910J	ARCO	1500-19-1000	2
C11	CAP. POLY. .01MF. 100V	PA2B100F	ELCUB	1500-41-0304	1
C12	CAP. POLY. .1MF. 100V	PA2B104F	ELCUB	1500-41-0404	1
C13	CAP. POLY. 1MF. 100V	210-81C-105F	IMP	1500-41-0504	1
C14 C15	CAP. POLY. 5MF. 100V	C1A305F	ELPAC	1500-45-0504	2

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REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PY
R120 R124	POT. TRIM. 100K	Y1AR100K	BECK	4600-01-0402	2
R2	POT. TRIM. 200	Y1AR200	BECK	4600-02-0101	1
R11 R21 R85 R94	POT. TRIM. 500	Y1AR500	BECK	4600-05-0104	4
R165 R192 R193	RES. C. 1/2W. 5%. 10	RC200F-100	STKPL	4700-25-0100	3
R189 R190 R194 R195	RES. C. 1/2W. 5%. 27	RC200F-270	STKPL	4700-25-0270	4
R8 R9 R95 R96	RES. C. 1/2W. 5%. 8.2	RC200F-822	STKPL	4700-25-0829	4
R100 R109 R121 R124 R272 R274 R299 R32 R33 R34 R5 R32 R6 R78 R81 R89	RES. HF. 1/8W. 1%. 100	RN550-1000F	TRM	4701-03-1000	14
R104 R107 R110 R115	RES. HF. 1/8W. 1%. 1K	RN550-1001F	TRM	4701-03-1001	4
R113 R116 R12 R123 R124 R140 R142 R174 R176 R179 R18 R245 R246 R280 R283 R287 R298	RES. HF. 1/8W. 1%. 10K	RN550-1002F	TRM	4701-03-1002	17
R213 R219 R222 R225 R228 R232 R242 R249 R244 R252 R255 R262 R288 R40	RES. HF. 1/8W. 1%. 100K	RN550-1003F	TRM	4701-03-1003	14
R56 R75 R76 R80 R84 R40 R48	RES. HF. 1/8W. 1%. 10	RN550-1009F	TRM	4701-03-1009	5
	RES. HF. 1/8W. 1%. 1.1K	RN550-1101F	TRM	4701-03-1101	2

WAVETEK PARTS LIST

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REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PY
R284	RES. HF. 1/8W. 1%. 221K	RN550-2213F	TRM	4701-03-2213	1
R130 R262 R269 R35 R43 R53 R68 R73	RES. HF. 1/8W. 1%. 2.37K	RN550-2371F	TRM	4701-03-2371	8
R248	RES. HF. 1/8W. 1%. 23.7K	RN550-2372F	TRM	4701-03-2372	1
R281	RES. HF. 1/8W. 1%. 237K	RN550-2373F	TRM	4701-03-2373	1
R180 R186 R203 R28 R39 R47 R51	RES. HF. 1/8W. 1%. 249	RN550-2490F	TRM	4701-03-2490	7
R203 R278 R99 R90	RES. HF. 1/8W. 1%. 2.49K	RN550-2491F	TRM	4701-03-2491	4
R204	RES. HF. 1/8W. 1%. 24.9K	RN550-2492F	TRM	4701-03-2492	1
R110 R112 R119 R44	RES. HF. 1/8W. 1%. 274	RN550-2740F	TRM	4701-03-2740	4
R214 R215 R220 R221 R243 R241 R246 R247 R261	RES. HF. 1/8W. 1%. 27.4K	RN550-2742F	TRM	4701-03-2742	9
R104 R136 R162	RES. HF. 1/8W. 1%. 2.87K	RN550-2871F	TRM	4701-03-2871	3
R150 R164 R178	RES. HF. 1/8W. 1%. 3.01K	RN550-3011F	TRM	4701-03-3011	3
R15 R16 R182 R22 R23 R91	RES. HF. 1/8W. 1%. 316	RN550-3160F	TRM	4701-03-3160	6
R122 R158 R4	RES. HF. 1/8W. 1%. 3.32K	RN550-3321F	TRM	4701-03-3321	3
R223 R224 R226 R227 R229 R230 R233 R234	RES. HF. 1/8W. 1%. 33.2K	RN550-3322F	TRM	4701-03-3322	14

WAVETEK PARTS LIST

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ASSEMBLY NO. 1100-00-0085

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NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DESIGN	BATCH	
MATERIAL	REV. DATE	TITLE	
FINISH	RELEASE APPROV	TOLERANCE UNLESS OTHERWISE SPECIFIED: DIM: 1/100 ANGLES: 11 XZ: 1/30	PARTS LIST MAIN BOARD
WAVETEK PROCESS	DO NOT SCALE DIMS	SCALE	
MODEL NO. 154		SHEET NO. 1100-00-0085	SHEET 1 OF 5
DATE: 23338			

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REV RCN BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PT
R200 R205	RES. HF. 1/8M. 1X. 54. 9	RN550-3489F	TRM	4701-03-3499	2
R126 R69 R71 R72	RES. HF. 1/8M. 1X. 56. 2	RN550-3482F	TRM	4701-03-3439	4
R181 R184	RES. HF. 1/8M. 1X. 57A	RN550-3740F	TRM	4701-03-3740	2
R291	RES. HF. 1/8M. 1X. 5. 74K	RN550-3741F	TRM	4701-03-3741	1
R23 R29	RES. HF. 1/8M. 1X. 6. 19K	RN550-6191F	TRM	4701-03-6191	2
R149 R207	RES. HF. 1/8M. 1X. 61. 9	RN550-6197F	TRM	4701-03-6199	2
R149	RES. HF. 1/8M. 1X. 6. 81K	RN550-6811F	TRM	4701-03-6811	1
R128 R129	RES. HF. 1/8M. 1X. 6. 98K	RN550-6981F	TRM	4701-03-6981	1
R151	RES. HF. 1/8M. 1X. 69. 8K	RN550-6982F	TRM	4701-03-6982	1
R14 R17	RES. HF. 1/8M. 1X. 7. 5K	RN550-7301F	TRM	4701-03-7301	2
R24* R270 R275 R277 R62	RES. HF. 1/8M. 1X. 825	RN550-8250F	TRM	4701-03-8250	3
R123 R160 R172 R63 R82 R83 R92	RES. HF. 1/8M. 1X. 8. 23K	RN550-8251F	TRM	4701-03-8251	7
R302	RES. HF. 1/8M. 1X. 82. 5	RN550-8285F	TRM	4701-03-8285	1
R37 R50	RES. HF. 1/8M. 1X. 90. 9	RN550-9099F	TRM	4701-03-9099	2
R36	RES. HF. 1/8M. 1X. 19A	RN400-19A0F	TRM	4701-13-19A0	1
R49	RES. HF. 1/8M. 1X. 332	RN400-3320F	TRM	4701-13-3320	1

WAVETEK PARTS LIST TITLE MAIN ASSEMBLY NO. 1100-00-0085 PAGE: 8 REV 8

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PT
CR88 CR89 CR90 CR91 CR92 CR93 CR94	DIODE, 2-75-777 STY: 2: 4807-02-0777	142-901-58	WVTK	4898-00-0003	1
CR11 CR12	DIODE, 2-75-777 STY: 2: 4807-02-0777	142-901-58	WVTK	4898-00-0003	1
876 877	TRANS	2N3694A	MDT	4901-02-3691	2
842 844	TRANS	2N3705A	NBC	4901-02-3705	2
841 85	TRANS	2N3643	FAIR	4901-03-3630	2
823 825 827 829 847 848 849 850 851 852 853 854 855 856 848 849 877 881	TRANS	2N3638A	CARTR	4901-03-6381	25
81 842 870 871	TRANS	2N3640	FAIR	4901-03-6400	4
834 836 840 835 836 837 847	TRANS	2N3643	FAIR	4901-03-6430	7
819 821 823 825 826 827 830 84 84 84 872 873 874 875 878 880	TRANS	2N3644	NBC	4901-03-6460	15
812 813 817 818 820 822 824 87 88	TRANS	2N3129	FAIR	4901-08-1390	9
883	TRANS	2N3486	MDT	4901-09-4860	1
810 811 814 838 829 89	TRANS	2N3771	NBC	4901-09-7710	6

WAVETEK PARTS LIST TITLE MAIN ASSEMBLY NO. 1100-00-0085 PAGE: 10 REV 8

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PT
R250 R251 R252 R254 R256 R257	RES. HF. 1/8M. 1X. 33. 2	RN550-3382F	TRM	4701-03-3329	4
R300 R38 R74 R77	RES. HF. 1/8M. 1X. 3. 63K	RN550-3651F	TRM	4701-03-3651	2
R10 R20	RES. HF. 1/8M. 1X. 3. 83K	RN550-3821F	TRM	4701-03-3821	1
R128 R175	RES. HF. 1/8M. 1X. 38. 3K	RN550-3823F	TRM	4701-03-3823	2
R103	RES. HF. 1/8M. 1X. 392	RN550-3920F	TRM	4701-03-3920	1
R109 R161 R7	RES. HF. 1/8M. 1X. 3. 92K	RN550-3921F	TRM	4701-03-3921	3
R137 R139 R173 R177	RES. HF. 1/8M. 1X. 4. 03K	RN550-4021F	TRM	4701-03-4021	4
R447	RES. HF. 1/8M. 1X. 4. 33K	RN550-4321F	TRM	4701-03-4321	1
R70 R79	RES. HF. 1/8M. 1X. 44A	RN550-4640F	TRM	4701-03-4640	2
R101 R102	RES. HF. 1/8M. 1X. 44. 4	RN550-4644F	TRM	4701-03-4649	2
R144 R271	RES. HF. 1/8M. 1X. 4. 73K	RN550-4751F	TRM	4701-03-4751	2
R121 R225 R276 R284 R290	RES. HF. 1/8M. 1X. 47. 5K	RN550-4752F	TRM	4701-03-4752	3
R149 R148 R41	RES. HF. 1/8M. 1X. 499	RN550-4990F	TRM	4701-03-4990	2
R185	RES. HF. 1/8M. 1X. 4. 99K	RN550-4991F	TRM	4701-03-4991	1
R42 R45 R61 R65	RES. HF. 1/8M. 1X. 911	RN550-5110F	TRM	4701-03-5110	4
R208	RES. HF. 1/8M. 1X. 51. 1	RN550-5111F	TRM	4701-03-5111	1

WAVETEK PARTS LIST TITLE MAIN ASSEMBLY NO. 1100-00-0085 PAGE: 7 REV 8

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PT
R198 R197 R198 R199 R209	RES. HF. 1/4M. 1X. 49. 9	RN400-4999F	TRM	4701-13-4999	8
R201 R206	RES. HF. 1/4M. 1X. 71. 5	RN400-7185F	TRM	4701-13-7159	2
R141 R171	RES. DET. 2-10K. 1/8M QTY: 2: 4701-03-1002	142-301-84	WVTK	4789-00-0018	1
CR13 CR2 CR83	DIODE, ZENER 6. 2V	1N823A	NPC	4801-01-0823	3
CR18 CR20	DIODE	1N3716	GE	4802-01-3716	2
CR10 CR14 CR15 CR16 CR17 CR22 CR26 CR27 CR28 CR29 CR34 CR9	DIODE	PD777	FAIR	4807-02-0777	11
CR1 CR19 CR21 CR22 CR23 CR24 CR25 CR3 CR30 CR31 CR32 CR33 CR35 CR36 CR37 CR38 CR39 CR4 CR40 CR41 CR42 CR43 CR44 CR45 CR46 CR47 CR48 CR49 CR5 CR50 CR51 CR52 CR53 CR54 CR55 CR56 CR57 CR58 CR59 CR6 CR60 CR61 CR62 CR63 CR64 CR65 CR66 CR67 CR68 CR69 CR7 CR70 CR71 CR72 CR73 CR74 CR75 CR76 CR77 CR78 CR79 CR8 CR81 CR82 CR84 CR85 CR86 CR87	DIODE	1N4148	FAIR	4807-02-6486	75

WAVETEK PARTS LIST TITLE MAIN ASSEMBLY NO. 1100-00-0085 PAGE: 9 REV 8

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-WFOR-PART-NO	WFOR	WAVETEK NO.	QTY/PT
844 845	TRANS. DEL. 2N3219A STY: 1: 4901-02-2191	142-301-86	WVTK	4998-00-0001	2
813 816 831 832	TRANS. H/PR. 2N3543 STY: 2: 4901-03-3430	142-301-88	WVTK	4998-00-0004	2
883	TRANS. DEL. 2N3542 STY: 1: 4901-03-4430	142-301-89	WVTK	4998-00-0008	1
82 83	TRANS. H/PR. 2N3485 STY: 2: 4901-03-4850	142-301-53	WVTK	4998-00-0009	1
174	SWITCH ASBY PS	184-404	WVTK	3103-00-0007	1
NONE	BUTTON	J-32305-BLACK	CRL	3103-04-0003	7
838	IC	AD 812	ANDEV	7000-08-1200	1
IC2	IC	NC1595L	MDT	7000-19-9500	1
IC3	IC	CA-3028A	RCA	7000-30-2800	1
IC1	IC	CA3049T	RCA	7000-30-4900	1

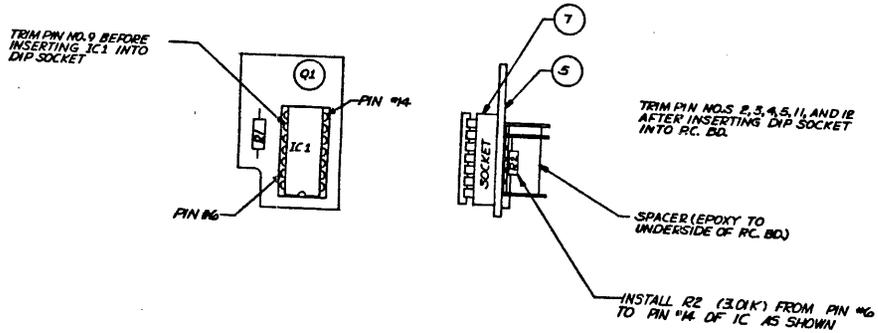
WAVETEK PARTS LIST TITLE MAIN ASSEMBLY NO. 1100-00-0085 PAGE: 11 REV 8

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE	WAVETEK 1100-00-0085
MATERIAL	REV/ENGR	
FINISH: WAVETEK PROCESS	RELEASE APPROV	PARTS LIST MAIN BOARD
	TOLERANCE UNLESS OTHERWISE SPECIFIED: DIM: 1/16" UNLESS NOTED HOLE: 1/32" UNLESS NOTED SCALE: DO NOT SCALE DIMS	
SCALE	REV NO	REV 8
	154	1100-00-0085
	23338	SHEET 2 OF 2

NOTE: UNLESS OTHERWISE SPECIFIED

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REV	BY	DATE
A	ECN NO. 1472	RO 02/78
B	REDRAWN (NO CHANGES)	DC 04/79
C	# 1999	DS 7-7-79

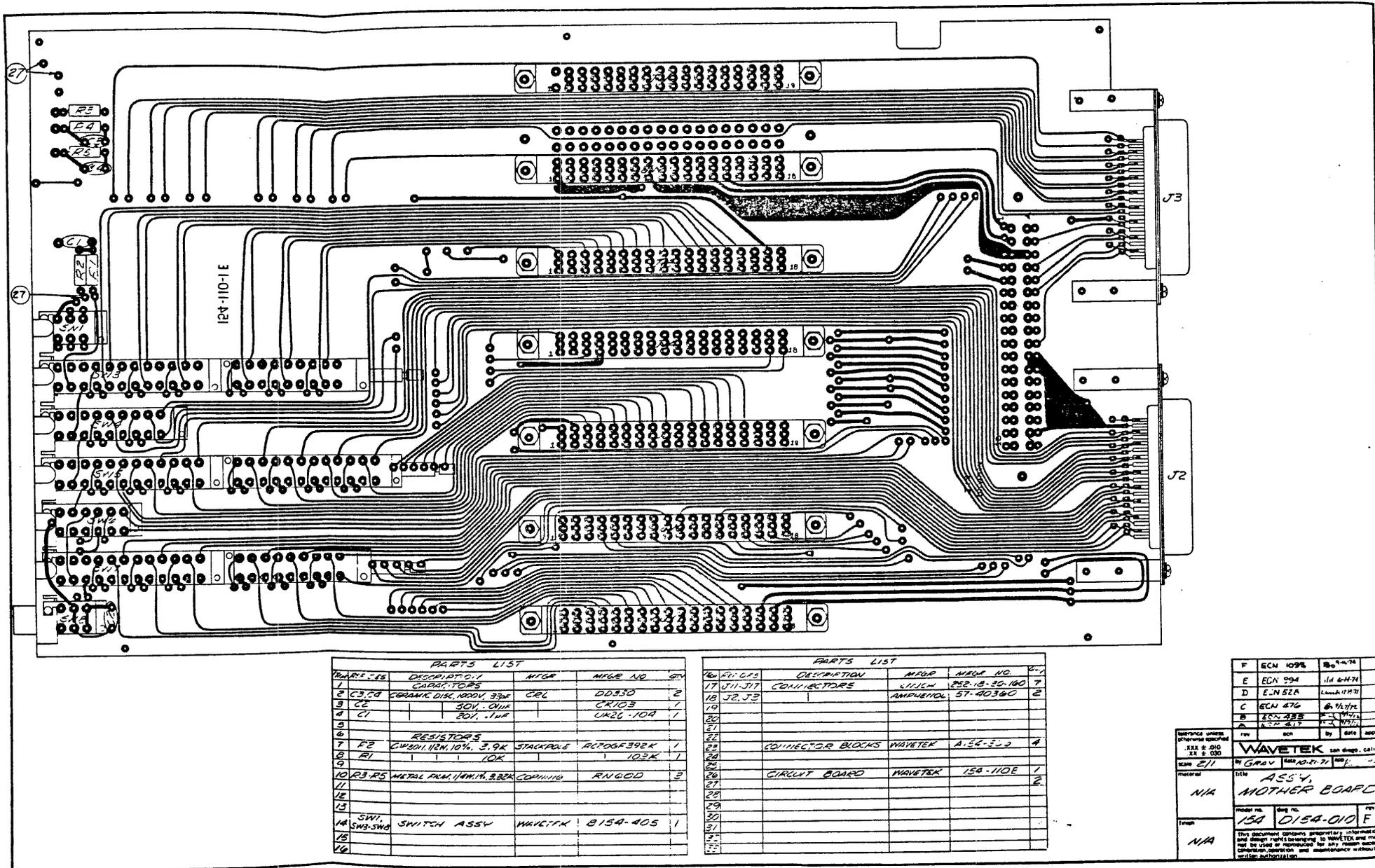


REFERENCE DESIGNATOR	PART DESCRIPTION	DIP-#FOR-PART-NO	#FOR	WAVETEK NO.	QTY/PT
3	SPACER	1480-00-6441			
5	CHIP REPLACEMENT BD	194-124	AVTR	1400-00-6441	1
7	INT. IC. 14PIN. 5M	CS4200-148C	AVTR	1700-00-0489	1
R2	RES. IC. 1/8W. 1%. 3.01K	RH030-3011F	SAE	2100-03-0002	1
Q1	RES. HF. 1/8W. 1%. 4.99K	RH030-4991F	TRM	4701-03-3011	1
Q1	TRANS	2K044A	HBC	4901-03-6440	1
IC1	IC	74LS74	TI	8000-74-7410	1

WAVETEK PARTS LIST TITLE: PATCH BLOCK ASSEMBLY NO. 1205-00-0489 REV. C
PAGE: 1

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DESIGN: D. COOPER	DATE: 02/78	
MATERIAL:	PROVIDER:	TITLE: PATCH BLOCK	
FINISH: WAVETEK PROCESS	RELEASE APPROV:	TOLERANCE UNLESS OTHERWISE SPECIFIED: .005" ±.000 ANGLES 11° ±.1°	DRAWING NO. 154 PART NO. 1205-00-0489 REV. C SHEET 2 OF 2
DO NOT SCALE DIMS			23338



PARTS LIST				
REF. DES	DESCRIPTION	MFR	MFR NO	QTY
CAPACITORS				
2	C3, C4	CERAMIC DISC, 1000V, 33PF	CEL DD330	2
3	C2	50V, 0.01UF	CR103	1
4	C1	20V, .1UF	UK26-104	1
RESISTORS				
7	R2	1/4W, 10%, 3.9K	STACKPAK R100GF392K	1
8	R1	10K	102K	1
10	R3-R5	METAL FILM, 1/4W, 1%, 3.32K	CORNING RNC00	2
14	SW1, SW2-SW3	SWITCH ASSY	NAVITEK 8154-405	1

PARTS LIST				
REF. DES	DESCRIPTION	MFR	MFR NO	QTY
16	J1-C15			
17	J11-J17	CONNECTORS	WILHE 852-18-25-180	7
18	J2, J3	AMPLIFOL	ST-40340	2
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REV 000 01 DATE 000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG. MFG. PART NO.	MFG.	WAVETEK NO.	QTY./PT.
NONE	SCHEMATIC, INSTRUMENT	0004-00-0041	WVTR	0004-00-0041	1
NONE	ASBY DRWG. MOTHER	0101-00-0080	WVTR	0101-00-0080	1
Z3	BLOCK, CONN	154-304	WVTR	1400-00-2873	4
C1 C2	CAP. CER. NON. .1UF. 50V	CAC032U1042000A	CORNB	1500-01-0403	2
C3 C4	CAP. CER. 33PF. 16V	00-330	CNL	1500-03-3011	2
NONE	MOTHER	154-110	WVTR	1700-00-0080	1
J2 J3	CONN	57-40240	AMPH	2100-02-0040	2
J11 J12 J13 J14 J15 J16 J17	CONN, EDGE CARD	252-18-30-140	CINCH	2100-03-0013	7
Z7	LAMP	787A	JXL	2400-02-0013	2
R1	RES. HF. 1/8W. 1%. 10K	RNS50-1008P	TRM	4701-03-1002	1
R3 R4 R5	RES. HF. 1/8W. 1%. 3.3K	RNS50-3321P	TRM	4701-03-3321	3
R8	RES. HF. 1/8W. 1%. 3.3K	RNS50-3321P	TRM	4701-03-3321	1
S4	SWITCH ASBY PB	154-405	WVTR	5103-00-0008	1
S8	BUTTON	J-92303-BLACK	CNL	5103-04-0003	7

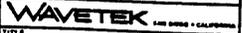
WAVETEK
PARTS LIST

TITLE
MOTHER

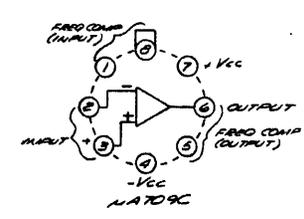
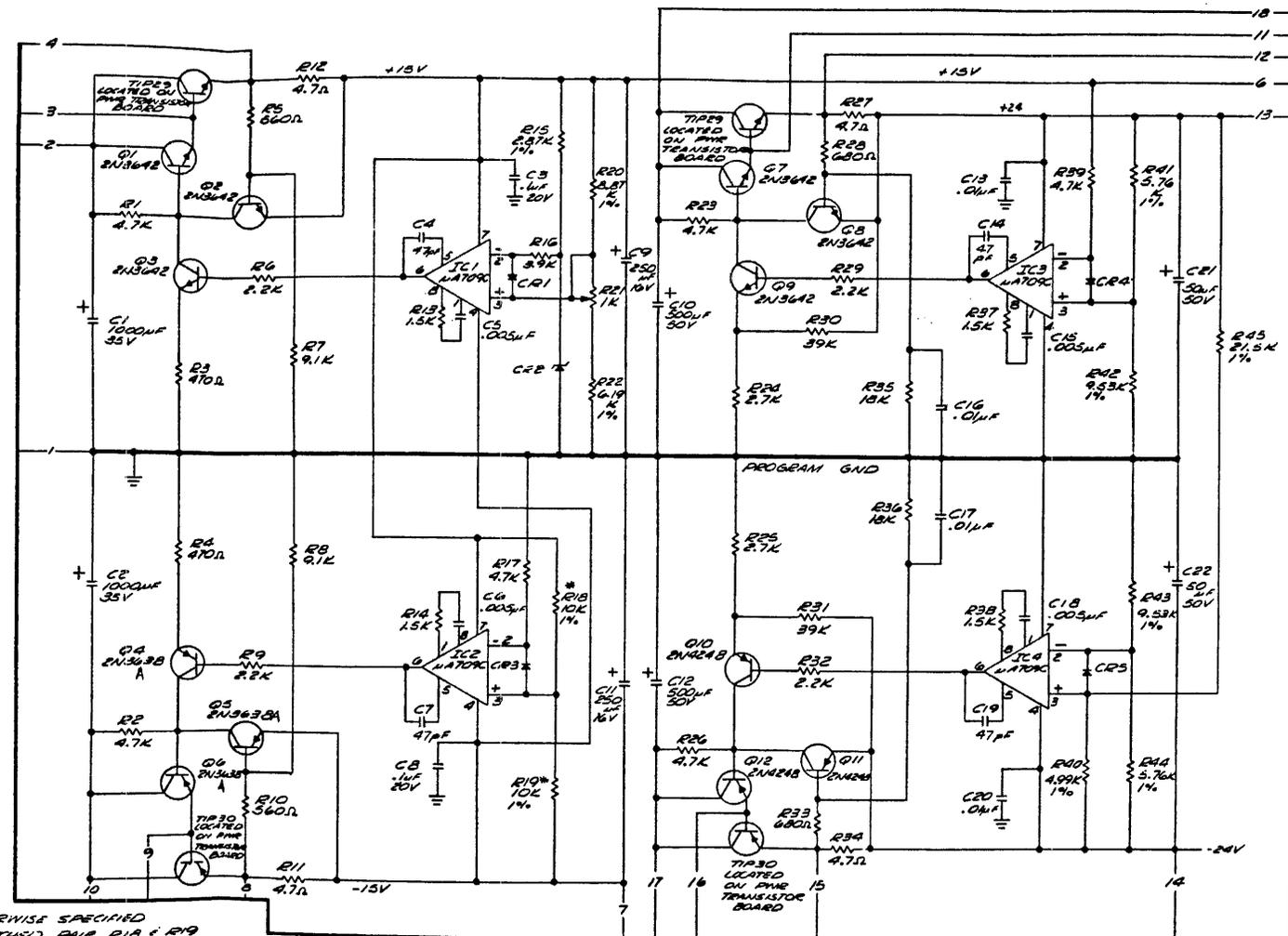
ASSEMBLY NO.
1100-00-0080
PAGE: 1

REV
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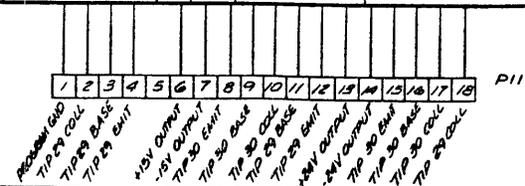
NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	SECTION	DATE	
MATERIAL	PREPARED		
	RELEASE APPROV		TITLE
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± 0.10 XX ± 0.05 Ø NOT SCALE DIMS		MOTHER BOARD
FINISH WAVETEK PROCESS	SCALE	MODEL NO. 154	REV OR 1100-00-0080
		DATE 23338	REV G

REV. 1/78



NOTES: UNLESS OTHERWISE SPECIFIED
 1. * INDICATES ANATOMIC PAIR, R18 & R19
 2. RESISTORS ARE CARBON, 1/8W, 1%
 3. DIODES ARE FD664G



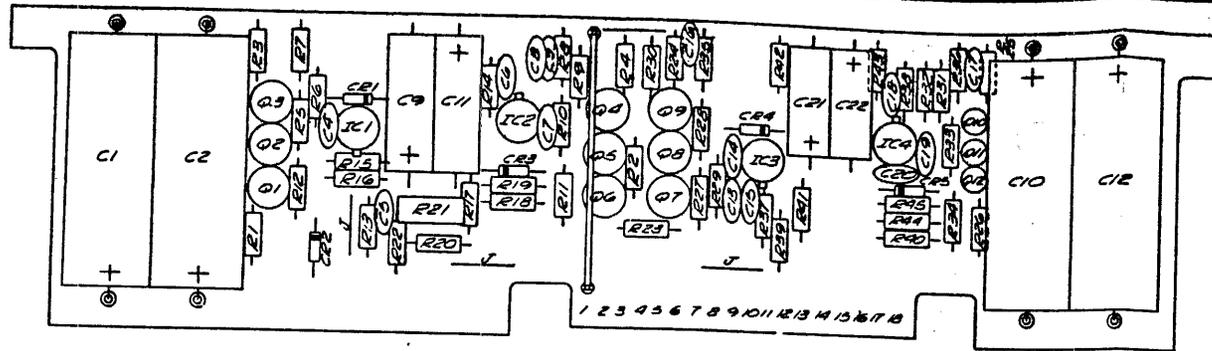
LAST REF DESIG
 R45 IC1
 C22 Q1E
 C25

D	ECN 1857	SAH	11-29-78
C	ECN 1599	ED	8/11
B	ECN 1391	ES	1-14-78
A	ECN 235	ECN	10/10/78

ISS & QIG	XX 2 000	WAVETEK	USE DESIG. CALL
DATE	N/A	BY	GEARY
REV	N/A	CHK	3-28-78
DATE	154	BY	0103-00-0081
REV	N/A	CHK	

SCHEMATIC, 15V, 24V POWER SUPPLY

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NOTE: R5 & R10;
 WHEN USING 1/8 WATT RESISTORS
 THESE VALUES SHOULD BE 600Ω.

REV	0	ECN 17857	DATE	7/28/78	
REV	B	ECN 1381	DATE	2/17/78	
REV	A	477	DATE	2/11/78	
DESIGNED BY	WAVETEK	DATE	100	100	
DESIGNED BY	WAVETEK	DATE	100	100	
REV	0/1	BY	GENIV	DATE	6-22-77
MATERIAL	N/A	DATE	ASSEMBLY, 15V, 20V POWER SUPPLY		
REV	N/A	DATE	15A	0101-00-0081	
REV	N/A	DATE			

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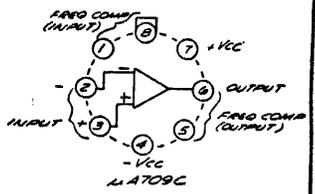
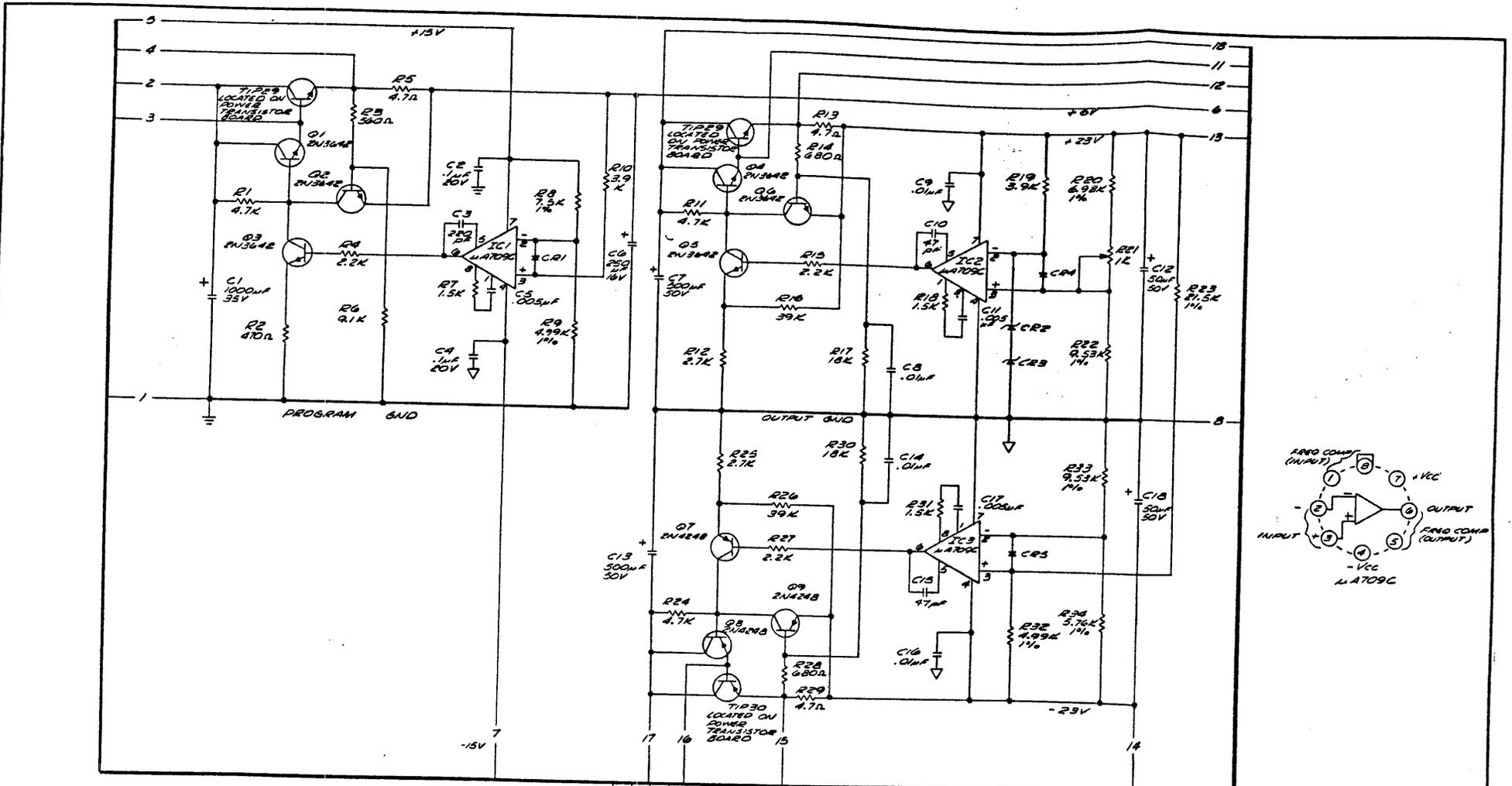
REFERENCE DESIGNATION	PART DESCRIPTION	ORIG-MFGN-PART-NO	MFG	WAVTEK NO.	QTY/P1
NONE	ASBY DRNG,POWER	0101-00-0001	HVTA	0101-00-0001	1
NONE	SCHEMATIC,PDWEM	0103-00-0001	HVTA	0103-00-0001	1
C13 C16 C17 C20	CAP,CER.,.01MF,50V	CA-103	LML	1500-01-0310	4
C3 C4	CAP,CER.,.1MF,20V	UN20-10A	CHL	1500-01-0413	2
C14 C18 C4 C7	CAP,CER.,.075P,10V	DD-470	ARCO	1500-04-7011	4
C15 C18 C5 C4	CAP,CER.,.005MF,50V	CA-502	CHL	1500-05-0210	4
C1 C2	CAP,ELECT.,1000PF,15V	1901000035GL6	SPHAG	1500-31-0212	2
C11 C9	CAP,ELECT.,250MF,10V	5000257G01NDP7	SPHAG	1500-32-5101	2
C21 C22	CAP,ELECT.,500PF,50V	500050405000J7	SPHAG	1500-35-0003	2
C10 C12	CAP,ELECT.,500MF,50V	1095076050GL6	SPHAG	1500-34-0103	2
NONE	PDWEM	154-111	HVTA	1700-00-0001	1
NONE	TRANSFORMER	101234	MC102	2000-11-0003	0
R21	POT,TRIMP,1K	V1013K	HYCK	0600-01-0209	1
R11 R12 R27 R34	RES,C-1/2W,50A,7	RC20GF-447	SINPL	4700-25-0470	4
R13 R14 R27 R30	RES,HP,1/8W,1%,1.5K	HM55D-1501F	THW	4701-03-1501	4
R35 R36	RES,HP,1/8W,1%,10.2K	HM55D-1022F	THW	4701-03-1022	2
R45	RES,HP,1/8W,1%,21.5K	HM55D-2152F	THW	4701-03-2152	1
R24 R32 R4 R9	RES,HP,1/8W,1%,2.21K	HM55D-2211F	THW	4701-03-2211	4
WAVETEK PARTS LIST		TITLE 15V PDWEM	ASSEMBLY NO. 1100-00-0001 PAGE 1	REV D	

REFERENCE DESIGNATION	PART DESCRIPTION	ORIG-MFGN-PART-NO	MFG	WAVTEK NO.	QTY/P1
D10 D11 D12	TRANS	2M4200	FAIR	0001-00-2000	3
IC1 IC2 IC3 IC4	IC,CLASS 11,PA-700 DT1117000-07-0000	130-501-10	HVTK	7200-00-0000	4
WAVETEK PARTS LIST		TITLE 15V PDWEM	ASSEMBLY NO. 1100-00-0001 PAGE 1	REV D	

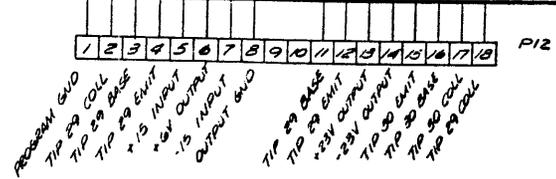
REFERENCE DESIGNATION	PART DESCRIPTION	ORIG-MFGN-PART-NO	MFG	WAVTEK NO.	QTY/P1
R15 R24 R25	RES,HP,1/8W,1%,2.07K	HM55D-2071F	THW	4701-03-2071	3
R16	RES,HP,1/8W,1%,1.03K	HM55D-1031F	THW	4701-03-1031	1
R30 R31	RES,HP,1/8W,1%,30.3P	HM55D-3032F	THW	4701-03-3032	2
R3 R4	RES,HP,1/8W,1%,0.00K	HM55D-0000F	THW	4701-03-0000	2
R1 R17 R2 R23 R26 R39	RES,HP,1/8W,1%,0.15K	HM55D-0151F	THW	4701-03-0151	0
R40	RES,HP,1/8W,1%,0.00K	HM55D-0001F	THW	4701-03-0001	1
R41 R44	RES,HP,1/8W,1%,4.70K	HM55D-4701F	THW	4701-03-4701	2
R22	RES,HP,1/8W,1%,0.10K	HM55D-0101F	THW	4701-03-0101	1
R10 R20 R33 R5	RES,HP,1/8W,1%,0.01K	HM55D-0010F	THW	4701-03-0010	4
R26	RES,HP,1/8W,1%,0.07K	HM55D-0071F	THW	4701-03-0071	1
R7 R8	RES,HP,1/8W,1%,0.00K	HM55D-0001F	THW	4701-03-0001	2
R42 R43	RES,HP,1/8W,1%,0.50K	HM55D-0531F	THW	4701-03-0531	2
R10 R19	RES,BET,2-10K,1/8W DTF214701-05-1002	102-501-00	HVTA	4700-00-0010	1
C20	DIODE	1M4501	MICRO	4001-01-4501	1
C31 C43 C44 C46	DIODE	FD-0000	PAJW	4007-02-0000	4
R4 05 06	TRANS	2N3100A	CARTM	4901-03-0311	3
D1 D2 D3 D7 D4 D0	TRANS	2M4002	PAJW	4001-03-0020	0
WAVETEK PARTS LIST		TITLE 15V PDWEM	ASSEMBLY NO. 1100-00-0001 PAGE 2	REV D	

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA	
MATERIAL	PROJ/ENG		TITLE 15V, 24V POWER SUPPLY	
	RELEASE APPROV		TOLERANCE UNLESS OTHERWISE SPECIFIED XREF: STD ANGLES: 1	
FINISH	WAVETEK PROCESS		DO NOT SCALE DIMS	SCALE
			MODEL NO 154	REV NO 1100-00-0001
			REV D	
			23338	SHEET OF



NOTES: UNLESS OTHERWISE SPECIFIED
 1. RESISTORS ARE CARBON, 1/8W, 1%
 2. DIODES ARE FDG666



REF DESIG.
 R30 CBS
 C18 Q9
 IC3 Q9

C	ECN 1509	30	1/1/83
D	ECN 1381	20	1/13/82
A	ECN 955	24	1/1/81
REV	REV	BY	DATE
WAVETEK 100 Diego, Calif			
DATE	N/A	BY	5/28/77
REVISED	N/A	TITLE	SCHEMATIC
			6V, 25V
			POWER SUPPLY
MODEL NO.	154	REV NO.	0103-00-0089
			C

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REV SCR BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-PFR-PART-NO	MFG	AVETER NO.	QTY/PKT
NONE	ASST OHM. POWR	0101-00-000V	WVTR	0101-00-000V	1
NONE	SCHEMATIC. POWR	0103-00-000V	WVTR	0103-00-000V	1
C10 C16 CB C9	CAP. CLM. .01MP. 50V	CA-103	CHL	1500-01-0310	4
C2 C4	CAP. CLM. .1MP. 20V	UA20-10A	AMEO	1500-01-0015	2
C3	CAP. CLM. 200PF. 1KV	DU-221	CHL	1500-02-2111	1
C10 C15	CAP. CLM. 47PF. 1KV	DU-270	CHL	1500-04-7011	2
C11 C17 C5	CAP. CE. .005MP. 50V	CK-502	CHL	1500-04-0210	3
C1	CAP. ELECT. 1000PF. 35V	3V01066350GL6	SPRAG	1500-11-0210	1
C6	CAP. ELECT. 250MP. 10V	500025700100F7	SPRAG	1500-12-5101	1
C12 C18	CAP. ELECT. 50MP. 50V	500050060500U7	SPRAG	1500-34-0003	2
C13 C7	CAP. ELECT. 500MP. 50V	5V05070500GL6	SPRAG	1500-34-0103	2
NONE	POWTR	150-111	WVTR	1700-00-0001	1
R21	MUT. TRM. 1K	91AR1K	HECC	400-01-0200	1
R13 R20 R5	RES. C. 1/2W. 10.4.7	HC20CF-407	DIAPL	4700-25-0070	3
R10 R31 R7	RES. MP. 1/8W. 10.1.15A	HN550-1501F	TNA	4701-03-1501	3
R17 R30	RES. MP. 1/8W. 10.1.10.2A	HN550-1022F	TNA	4701-03-1022	2
R23	RES. MP. 1/8W. 10.1.21.3A	HN550-2152F	TNA	4701-03-2152	1
R15 R27 R6	RES. MP. 1/4W. 10.2.21A	HN550-2211F	TNA	4701-03-2211	3
WAVETEK PARTS LIST		TITLE BY POWR	ASSEMBLY NO. 1100-00-0089 PAGE: 1	REV A	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-PFR-PART-NO	MFG	AVETER NO.	QTY/PKT
R12 R25	RES. MP. 1/8W. 10.2.07A	HN550-2071F	TNA	4701-03-2071	2
R16 R26	RES. MP. 1/8W. 10.30.2A	HN550-3020F	TNA	4701-03-3020	2
R10 R19	RES. MP. 1/8W. 10.3.92A	HN550-3921F	TNA	4701-03-3921	2
R2	RES. MP. 1/8W. 10.00A	HN550-0000F	TNA	4701-03-0000	1
R1 R31 R20	RES. MP. 1/8W. 10.4.75A	HN550-0751F	TNA	4701-03-0751	3
R32 R9	RES. MP. 1/8W. 10.4.90A	HN550-0901F	TNA	4701-03-0901	2
R3	RES. MP. 1/8W. 10.570A	HN550-5700F	TNA	4701-03-5700	1
R30	RES. MP. 1/8W. 10.5.70A	HN550-5701F	TNA	4701-03-5701	1
R14 R20	RES. MP. 1/8W. 10.0A	HN550-0010F	TNA	4701-03-0010	2
R20	RES. MP. 1/8W. 10.0.70A	HN550-0701F	TNA	4701-03-0701	1
R8	RES. MP. 1/8W. 10.0.00A	HN550-0001F	TNA	4701-03-0001	1
R6	RES. MP. 1/8W. 10.7.30A	HN550-7301F	TNA	4701-03-7301	1
R22 R33	RES. MP. 1/8W. 10.0.00A	HN550-0001F	TNA	4701-03-0001	1
R4	RES. MP. 1/8W. 10.0.53A	HN550-0531F	TNA	4701-03-0531	2
CR2 CR3	DIODE	1N4501	ICRO	4001-01-0501	2
CR1 CR4 CR5	DIODE	FD-0000	FAIR	4007-02-0000	3
Q1 Q2 Q3 Q4 Q5 Q6	TRANS	2N3642	FAIR	4001-03-0020	6
Q7 Q8 Q9	TRANS	2N0240	FAIR	4001-00-2000	3
IC1 IC2 IC3	IC. CLASS II. PA-700	110-501-10	WVTR	7200-00-0000	3
WAVETEK PARTS LIST		TITLE BY POWR	ASSEMBLY NO. 1100-00-0089 PAGE: 2	REV A	

REV. 10-1988 (PARTS LIST) (REV. 10-1988)

REV. 10-1988 (PARTS LIST) (REV. 10-1988)

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE	WAVETEK SAN JOSE - CALIFORNIA
MATERIAL	RELEASE APPROV	
FINISH WAVETER PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± 0.00 ANGLES 11° 25 ± .00	TITLE 6V, 23V POWER SUPPLY
DO NOT SCALE DIMS	SCALE	MODEL NO 154
		ASSEMBLY NO 1100-00-0089
		REV A
		DATE 23338
		SHEET OF

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REV ECN BY DATE APP

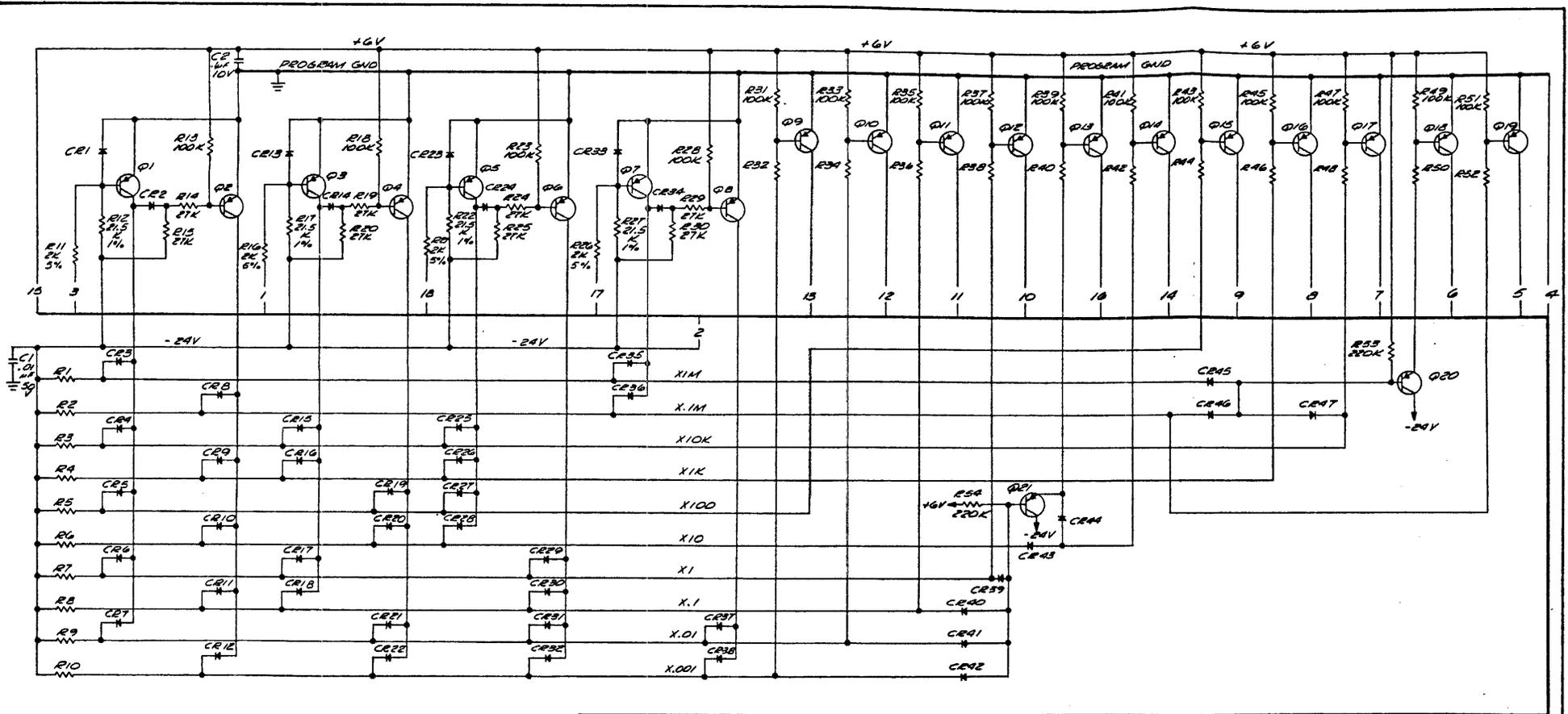
REFERENCE DESIGNATORS	PART DESCRIPTION	QWIC-PFGH-PART-NO	HPLW	WAVETER NO.	UTV/PT
NONE	ASST QWAS-D-A CONV	8101-00-0085	NVTK	8101-00-0085	1
NONE	SCHEMATIC-D-A CONV	0103-00-0065	NVTK	8103-00-0065	1
CS	CAP, C24, .1MF, 10V	UK10-104	ANCO	1500-01-0012	1
C1 C2	CAP, CER, .1MF, 20V	UK20-104	ANCO	1500-01-0013	2
NONE	U-R CONV	156-113	NVTK	1700-00-0003	1
NONE	TRANSFORM	10143R	MELKS	2000-11-0003	1
H12 H17 H20 H21 H27 H28 H48 H55 H61 H67 H7 H74	RES, HP, 1/8W, 1%, 10K	HN550-1002P	TW	4701-03-1002	12
H2	RES, HP, 1/8W, 1%, 12K	HN550-1200P	TW	4701-03-1200	1
H4	RES, HP, 1/8W, 1%, 10.2K	HN550-1022P	TW	4701-03-1022	1
H5b H75	RES, HP, 1/8W, 1%, 21.2K	HN550-2122P	TW	4701-03-2122	2
H8b	RES, HP, 1/8W, 1%, 221K	HN550-2213P	TW	4701-03-2213	1
H1 H10 H15 H20 H30 H35 H40 H47 H51 H59 H65 H72	RES, HP, 1/8W, 1%, 2.37K	HN550-2371P	TW	4701-03-2371	12
H11 H16 H23 H31 H39 H41 H46 H50 H6 H68 H66 H73 H76	RES, HP, 1/8W, 1%, 23.7K	HN550-2372P	TW	4701-03-2372	12
H25	RES, HP, 1/8W, 1%, 27.4K	HN550-2742P	TW	4701-03-2742	1
H5b H63 H66	RES, HP, 1/8W, 1%, 30.1K	HN550-3012P	TW	4701-03-3012	3
WAVETEK PARTS LIST		TITLE D-A CONVERTER	ASSEMBLY NO. 1100-00-0085	REV H	PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	QWIC-PFGH-PART-NO	HPLW	WAVETER NO.	UTV/PT
H33	RES, HP, 1/8W, 1%, 40.2K	HN550-0042P	TW	4701-03-0042	1
R3 R6	RES, HP, 1/8W, 1%, 6.75K	HN550-0751P	TW	4701-03-0751	4
H52 R58 R62 H71	RES, HP, 1/8W, 1%, 67.5K	HN550-0752P	TW	4701-03-0752	6
H15 R16 R19	RES, HP, 1/8W, 1%, 6.75K	HN550-0981P	TW	4701-03-0981	3
H36 H43	RES, HP, 1/8W, 1%, 69.8K	HN550-0982P	TW	4701-03-0982	2
H78	RES, HP, 1/8W, 1%, 6.25K	HN550-0251P	TW	4701-03-0251	1
H57 H64 H66 H70 H77	RES, HP, 1/8W, 1%, 1K	HN600-1004P	TW	4701-14-1004	5
H5	RES, HP, 1/8W, 1%, 332	HN600-3320P	TW	4701-13-3320	1
H51	RES, HP, 1/8W, 1%, 402K	HN600-0023P	TW	4701-13-0023	1
H14 H26 H21 H26 H27 H28 H44 H8	RES, SET, 10-10K, 1/8W UTV1074701-03-1082	134-500-07	NVTK	4700-00-0020	1
H30 H39 H46 H45	RES, SET, 10-10K, 1/8W UTV1074701-03-1083	154-500-08	NVTK	4700-00-0027	1
CR1 CR2 CR3 CR4 CR2 CR22 CR25 CR28 CR29 CR30 CR31 CR32 CR33 CR34 CR35 CR36 CR37 CR38 CR39 CR40 CR4 CR49	D1006	PD-0000	FAIR	0007-02-0000	26
CR10 CR11 CR13 CR16 CR18 CR17 CR18 CR20 CR21 CR23 CR26 CR26 CR27 CR3 CR4 CR5 CR7 CR6	DIU06, SET, 10-10K, 1/8W UTV1074701-02-0000	134-500-09	NVTK	4000-00-0001	3
WAVETEK PARTS LIST		TITLE D-A CONVERTER	ASSEMBLY NO. 1100-00-0085	REV H	PAGE 2

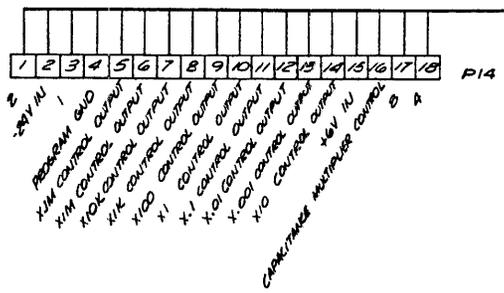
REFERENCE DESIGNATORS	PART DESCRIPTION	QWIC-PFGH-PART-NO	HPLW	WAVETER NO.	UTV/PT
Q1	TRANS	2H2905A	FAIR	4001-02-0001	1
Q10 Q11 Q12 Q13 Q18 Q15 Q16 Q17 Q18 Q19 Q2 Q20 Q21 Q22 Q23 Q24 Q25 Q3 Q4 Q5 Q6 Q7 Q8 Q9	TRANS	2H3040	FAIR	4001-03-0000	26
WAVETEK PARTS LIST		TITLE D-A CONVERTER	ASSEMBLY NO. 1100-00-0085	REV H	PAGE 3

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	QWIC	DATE	WAVETEK SAN DIEGO - CALIFORNIA
MATERIAL	PROCESSED	TITLE	
FINISH	RELEASE APPROV	TOLERANCE UNLESS OTHERWISE SPECIFIED X.XX (STD) ANGLES 1:1, 2:1, 3:1	D-A CONVERTER
WAVETER PROCESS	DO NOT SCALE DWG	WORK NO. 154	QWIC NO. 1100-00-0083
SCALE		REV B	SHEET 23338 OF



- NOTES: UNLESS OTHERWISE SPECIFIED
 1. ALL RESISTORS ARE 1/8W, 1% CARBON
 2. ALL RESISTORS ARE 33K
 3. ALL TRANSISTORS ARE 2N3638A
 4. ALL DIODES ARE 10G066



LAST REF DESIG
 R54
 CR47
 CR1
 CR2

C	ECN	REV	B. S. 211	11/72
3	ECN	1500	10	11/72
A	ECN	982	11/72	11/72
118	N/A	118	118	118
WAVETEK 1000000000				
154 0103-00-0092				
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REV _____ SCH _____ BY _____ DATE _____ APP _____

REFERENCE DESIGNATORS	PART DESCRIPTION	Q18-MGR-PART-NO	MGR	WAVTEK NO.	QTY/PKT
NONE	ASSY DRNG, MATHE	0181-00-0002	WVTK	0181-00-0002	1
NONE	SCHEMATIC, MATHE	0183-00-0002	WVTK	0183-00-0002	1
C1	CAP, CLR., 01MF, 50V	CA-100	CHL	1500-01-0310	1
C2	CAP, CLR., 1MF, 10V	U410-100	CHL	1500-01-0612	1
NONE	RANGE MATHE	150-112	WVTK	1700-00-0002	1
NONE	TRANSIPAD	101234	WVTK	2000-11-0005	21
R13 R10 R23 R20 R11 R15 R20 R27 R20 R01 R03 R05 R07 R08 R01	RES, MP, 170W, 10, 100W	W550-10030	10W	0701-03-1005	15
R11 R10 R21 R20	RES, MP, 170W, 10, 20	W550-20010	10W	0701-03-2001	0
R12 R17 R22 R27	RES, MP, 170W, 10, 21.5W	W550-21520	10W	0701-03-2152	0
R03 R06	RES, MP, 170W, 10, 201W	W550-20130	10W	0701-03-2013	2
R10 R15 R10 R20 R20 R20 R20 R20	RES, MP, 170W, 10, 27.4W	W550-27020	10W	0701-03-2702	0
R1 R10 R2 R3 R10 R20 R10 R10 W0 R00 R00 R00 R00 R00 R0 R0 R02 R0 R7 R0 R0	RES, MP, 170W, 10, 33.2W	W550-33220	10W	0701-03-3322	21
CR1 CR20 CR11 CR12 CR15 CR10 CR10 CR10 CR17 CR10 CR19 CR2 CR20 CR21 CR22 CR23	DIODE	FD-0000	PA1W	0007-02-0000	07

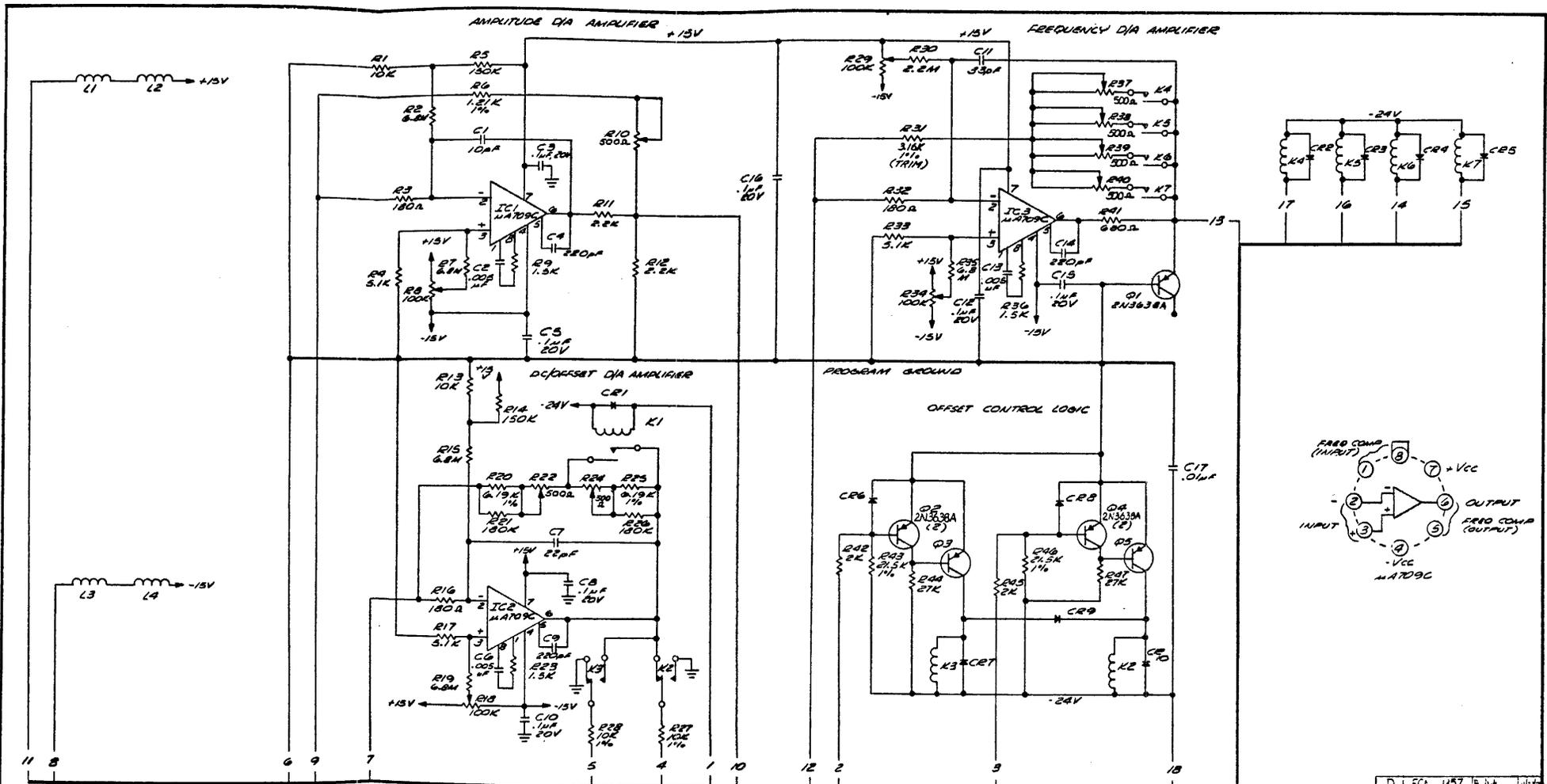
WAVETEK PARTS LIST TITLE RANGE MATHE ASSEMBLY NO. 1100-00-0002 REV A PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	Q18-MGR-PART-NO	MGR	WAVTEK NO.	QTY/PKT
CR06 CR25 CR20 CR27 CR20 CR20 CR3 CR00 CR10 CR32 CR33 CR10 CR14 CR30 CR37 CR10 CR30 CR0 CR00 CR01 CR02 CR00 CR00 CR00 CR00 CR07 CR5 CR0 CR7 CR0 CR0	TRANS	2730500	CANTW	0001-03-0301	21
Q1 Q10 Q11 Q12 Q15 Q10 Q10 Q10 Q17 Q10 Q10 Q2 Q20 Q21 Q1 W0 W5 Q0 Q7 Q0 Q0					

WAVETEK PARTS LIST TITLE RANGE MATHE ASSEMBLY NO. 1100-00-0002 REV A PAGE 2

NOTE UNLESS OTHERWISE SPECIFIED

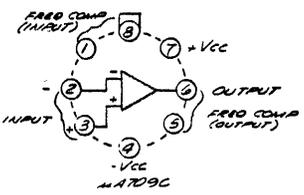
REMOVE ALL BURRS AND BREAK SHARP EDGES	FINISH	DATE	WAVETEK SAN DIEGO - CALIFORNIA
MATERIAL	PROFESSOR	TITLE	
FINISH	RELEASE APPROV	FREQUENCY RANGING	
WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED X.XX - 5% X.X - 10% X - 20% DO NOT SCALE DIMS	FORM NO. 154	REV. NO. 1100-00-0002 A
		CODE 23338	SHEET 09



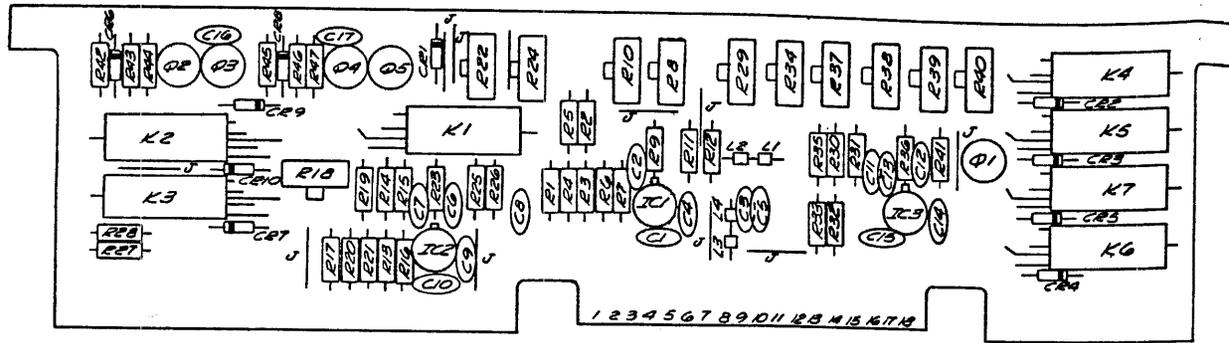
NOTES: UNLESS OTHERWISE SPECIFIED
 1. RESISTORS, CARBON, 1/2W, 10%
 2. DIODES ARE 100666

- 1 DC OFFSET AMP GAIN CONTROL
- 2 DC OFFSET POSITION (SEE INSTRUCTIONS)
- 3 DC OFFSET DIA AMP INPUT
- 4 DC OFFSET DIA AMP OUTPUT
- 5 PROGRAM GROUND
- 6 DC OFFSET DIA AMP INPUT
- 7 AMPLITUDE DIA AMP INPUT
- 8 AMPLITUDE DIA AMP OUTPUT
- 9 FREQUENCY DIA AMP INPUT
- 10 FREQUENCY DIA AMP OUTPUT
- 11 X10 FREQ CALIB CONTROL
- 12 X100 FREQ CALIB CONTROL
- 13 X10 FREQ CALIB CONTROL
- 14 -24V IN

LAST R&R DESIG
 R47 Q5
 C17 K7
 IC3 IC3
 L4



D	ECN 1357	E d/t	1/87
C	ECN 1097	E d/t	8/7/76
B	ECN 694	E d/t	8/2/76
A	ECN 435	E d/t	7/2/76
1/14 VEYTEK 510 MORGAN C111 N/A GRAN 116-377 100/11/76 N/A N/A SCHEMATIC, DIA AMPLIFIERS 134 D103-00-0084 N/A			



B		ECN 1927	DTB 7-8-73
A		ECN 834	8-1-69-76
REV	DATE	BY	CHKD
1	8-1-69	WAV	WAV
WAVETEK			
110			
ASSEMBLY			
D-A AMPLIFIER			
MODEL NO.	QWG NO.	REV	
154	0101-00-0084	B	
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REV ECR BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	UNIT-PART-NUM	MPN	WAVETEK NO.	QTY/P1
NONE	ASST D-4 AMPLIFIER	0101-00-0000	AVTA	0101-00-0000	1
NONE	SCHEMATIC D-4 AMP	0101-00-0000	AVTA	0103-00-0000	1
C1	CAP. CER. 100P. 1KV	00-100	CR1	1500-01-0011	1
C17	CAP. CER. .01MF. 50V	CA-105	CH1	1500-01-0310	1
C18 C19 C15 C16 C3 C5 C8	CAP. CER. .1MF. 20V	1000-100	CH1	1500-01-0013	7
C7	CAP. CER. .22PF. 1KV	00-220	ANCO	1500-02-2011	1
C10 C4 C9	CAP. CER. .22PF. 1KV	00-220	ANCO	1500-02-2111	3
C11	CAP. CER. .33PF. 1KV	00-330	ANCO	1500-03-3011	1
C13 C2 C6	CAP. CER. .005MF. 10V	CA-502	CH1	1500-03-0210	3
NONE	D-4 AMP	150-110	AVTA	1700-00-0000	1
NONE	TRANSIPAD	10123N	MTNB	2000-11-0003	5
L1 L2 L3 L4	PERMITE BEAD	50-500-05/50	PEMB	3100-00-0001	4
R1 R4 R5 R6 R7	RELAY. HEO. FORM-A	PR-000	PHPP	4500-00-0000	5
R2 R3	RELAY. HEO. FORM-C	PR-005	PHPP	4500-00-0005	2
R10 R29 R30 R8	POT. 10K. 100K	91A100K	MECH	4000-01-1002	4
R16 R22 R24 R37 R38 R39 R40	POT. 10K. 500	91A500	MECH	4000-05-0100	7
R50	RES. C. 1/2W. 100. 2.2M	RC200P-220	STAPL	4700-25-2200	1

WAVETEK PARTS LIST TITLE D-4 AMPLIFIER ASSEMBLY NO. 1100-00-0004 PAGE 1 REV 9

REFERENCE DESIGNATORS	PART DESCRIPTION	UNIT-PART-NUM	MPN	WAVETEK NO.	QTY/P1
IC1 IC2 IC3	IC. CLASS 1. MA-700 0771117000-07-0000	130-501-13	AVTA	7200-00-0005	3

WAVETEK PARTS LIST TITLE D-4 AMPLIFIER ASSEMBLY NO. 1100-00-0004 PAGE 3 REV 9

REFERENCE DESIGNATORS	PART DESCRIPTION	UNIT-PART-NUM	MPN	WAVETEK NO.	QTY/P1
R15 R14 R2 R35 R7	RES. C. 1/2W. 100. 0.0M	RC200P-005	STAPL	4700-25-0000	5
R1 R15 R27 R20	RES. MF. 1/8W. 10. 10K	RA550-1002P	TAN	4701-03-1002	4
R6	RES. MF. 1/8W. 10. 1.21K	RA550-1211P	TAN	4701-03-1211	1
R23 R36 R9	RES. MF. 1/8W. 10. 1.5K	RA550-1501P	TAN	4701-03-1501	3
R10 R5	RES. MF. 1/8W. 10. 1.50K	RA550-1503P	TAN	4701-03-1503	2
R21 R26	RES. MF. 1/8W. 10. 1.70K	RA550-1703P	TAN	4701-03-1703	2
R16 R1 R32	RES. MF. 1/8W. 10. 200	RA550-2000P	TAN	4701-03-2000	3
R02 R05	RES. MF. 1/8W. 10. 2K	RA550-2001P	TAN	4701-03-2001	2
R03 R06	RES. MF. 1/8W. 10. 21.5K	RA550-2150P	TAN	4701-03-2150	2
R11 R12	RES. MF. 1/8W. 10. 2.21K	RA550-2211P	TAN	4701-03-2211	2
R00 R07	RES. MF. 1/8W. 10. 27.4K	RA550-2702P	TAN	4701-03-2702	2
R17	RES. MF. 1/8W. 10. 3.10K	RA550-3101P	TAN	4701-03-3101	1
R17 R33 R4	RES. MF. 1/8W. 10. 0. 50K	RA550-0001P	TAN	4701-03-0001	3
R20 R25	RES. MF. 1/8W. 10. 0. 10K	RA550-0101P	TAN	4701-03-0101	2
R41	RES. MF. 1/8W. 10. 0.001	RA550-0010P	TAN	4701-03-0010	1
CR1 CR10 CR3 CR4 CR6 CR5 CR8 CR7 CR9 CR9	DIODE	7D-0000	PA10	0007-02-0000	10
D1 D2 D3 D4 D5	TRANS	203030	CANTM	4001-03-0301	5

WAVETEK PARTS LIST TITLE D-4 AMPLIFIER ASSEMBLY NO. 1100-00-0004 PAGE 2 REV 9

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE	WAVETEK SAN DIEGO - CALIFORNIA
MATERIAL	PROJ. ENG.	
	RELEASE APPROV.	TITLE
		D-4 AMPLIFIER
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX: 0.00 ANGLES 21° Z: .00	MODEL NO.
	DO NOT SCALE DWG	154
	SCALE	DWG NO. 1100-00-0084
		REV B
		DATE 23328 SHEET OF

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REV ECR BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=PCB=PART=HU	HGR	WAVETEK NO.	QTY/P1
None	ASBY OPNG.VCG	0103-00-0086	WVTK	0103-00-0086	1
None	SCHEMATIC.VCG	0103-00-0086	WVTK	0103-00-0086	1
C16 C17	CAP.CER.,001MF,14V	DD-182	ARCO	1500-01-0211	2
C21 C23 C25	CAP.CER.,.01MF,50V	CR-183	CHL	1500-01-0310	3
C22 C24	CAP.CER.,.1MF,20V	UK28-100	CHL	1500-01-0413	2
C11 C13 C15 C2 C4 C5 C7	CAP.CER.,220PF,14V	DD-221	ANCO	1500-02-2111	7
C16	CAP.CER.,47PF,14V	DD-070	ANCO	1500-04-7011	1
C14 C20	CAP.CER.,470PF,14V	DD-071	ARCO	1500-04-7111	2
C1 C10 C12 C14 C3 C6	CAP.CER.,.005MF,50V	CK-502	CHL	1500-05-0210	6
C8 C9	CAP.POLY.C,5MF,100V	C1450P	ELPAC	1500-05-0500	2
44	VCG	154-116	WVTK	1700-00-0000	1
R2 R1 C6	RELAY,REED,FORM-A	PS-004	PHIPP	4500-00-0000	5
R10 R07 R7	POT,TRIM,100K	R14100K	DECK	4000-01-0002	3
R15	POT,TRIM,500	R140500	DPCR	4000-05-0100	1
R10 R30	RES.C,1700-10K,0.5W	VC200P-005	STAPL	4700-25-0000	2
R11 R11 R25 R40 R54	RES.MF,1700-10K,10A	H4550-1001P	TH	4701-01-1001	5
R16 R37	RES.MF,1700-10K,10A	H4550-1002P	TH	4701-03-1002	2

WAVETEK PARTS LIST TITLE VCG ASSEMBLY NO. 1100-00-0086 PAGE: 1 REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=PCB=PART=HU	HGR	WAVETEK NO.	QTY/P1
R16 R37	RES.MF,1700-10K,10A PART UP 4700-00-0033 UT(12)	142-501-50	WVTK	4700-00-0033	1
R18 R19	RES.MF,1700-10K,10A PART UP 4700-00-0033 UT(12)				
R30 R21	RES.MF,1700-10K,10A PART UP 4700-00-0033 UT(12)				
R22 R23	RES.MF,1700-10K,10A PART UP 4700-00-0033 UT(12)				
	DIODE	FD-0000	PA1N	4847-07-0000	6
	TRANS	2-3030A	CA15	4001-03-0301	1
	TRANS	2-3030	PA2N	4001-03-0410	2
	TRANS	JH200	PA1A	4001-04-2000	1
	TRANS	2H000	HUT	4001-05-0000	1
	TRANS	1H-100	TPB	4002-10-0100	2
	TRANS,3P,2H4002 UT(11)4001-00-0020	142-501-54	AVTK	4000-00-0000	1
	I.C.CLASS 1,4P,700	110-501-15	WVTK	7200-00-0000	7

WAVETEK PARTS LIST TITLE VCG ASSEMBLY NO. 1100-00-0086 PAGE: 2 REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=PCB=PART=HU	HGR	WAVETEK NO.	QTY/P1
R42	RES.MF,1700-10K,10A	H4550-1000	TH	4701-01-1000	1
R41	RES.MF,1700-10K,10A	H4550-1001P	TH	4701-01-1101	1
R40	RES.MF,1700-10K,10A	H4550-1500P	TH	4701-01-1500	1
R14 R0 R20 R27 R8 R31 R12 R10 R45 R6 R4	RES.MF,1700-10K,10A	H4550-1501P	TH	4701-01-1501	11
R42 R43	RES.MF,1700-10K,10A	H4550-1502P	TH	4701-01-1502	2
R41	RES.MF,1700-10K,10A	H4550-1701P	TH	4701-01-1701	1
R40	RES.MF,1700-10K,10A	H4550-1800P	TH	4701-01-1800	1
R35	RES.MF,1700-10K,10A	H4550-2210	TH	4701-01-2210	1
R13	RES.MF,1700-10K,10A	H4550-0001P	TH	4701-01-0001	1
R10	RES.MF,1700-10K,10A	H4550-0000P	TH	4701-01-0000	1
R55	RES.MF,1700-10K,10A	H4550-0001P	TH	4701-01-0001	1
R50	RES.MF,1700-10K,10A	H4550-0002P	TH	4701-01-0002	1
R40	RES.MF,1700-10K,10A	H4550-0250P	TH	4701-01-0250	1
R40 R5	RES.MF,1700-10K,10A	H4550-2050P	TH	4701-01-2050	1
R24 R26 R20 R31 R4 R0	RES.BET,2-10K,1700 UT(12)4701-01-1001	142-501-00	WVTK	4700-00-0000	3

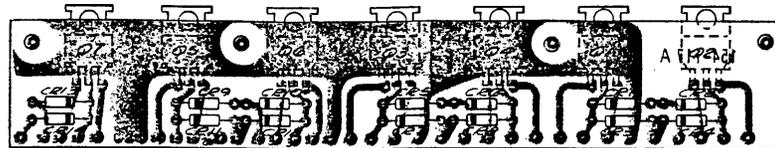
WAVETEK PARTS LIST TITLE VCG ASSEMBLY NO. 1100-00-0086 PAGE: 3 REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=PCB=PART=HU	HGR	WAVETEK NO.	QTY/P1
	UT(11)7000-07-0000				

WAVETEK PARTS LIST TITLE VCG ASSEMBLY NO. 1100-00-0086 PAGE: 4 REV F

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE	WAVETEK
MATERIAL	PREPARED	DATE
	CHECKED APPROV	TITLE
	TOLERANCE UNLESS OTHERWISE SPECIFIED	VCG BOARD
	3X - 0.08 ANGLES 1:1	
	3X - 0.08	
DO NOT SCALE DWG	SCALE	REV
	154	1100-00-0086 F
	2333B	SHEET OF



PARTS LIST				
QTY	REF DES	DESCRIPTION	MFG	WAVE NO.
1		DIODES		
2	CR1-CR4	5C8-1	SEMTECH	1A
3				
4				
5		TRANSISTORS		
6	Q1, Q3, Q5, Q7	TIP 29	TEXAS INSTRUMENT	TIP 29 4
7	Q2, Q4, Q6	TIP 30		TIP 30 3
8				
9				
10		CIRCUIT BOARD	WAVETEK	154-117A 1
11				
12				
13				

NOTES: UNLESS OTHERWISE SPECIFIED
 1. TRANSISTORS MOUNTED ON CIRCUIT SIDE

tolerance unless otherwise specified	rev	ecr	by	date	app
XXX ± 010 XX ± 030	WAVETEK San Diego, Calif				
scale 2/1	by	date	date	date	date
material	ASSEMBLY, TRANSISTOR MOUNTING BD				
N/A	154 0154-017				
finish	This document contains proprietary information and design rights belonging to WAVETEK and may not be used or reproduced for any reason without WAVETEK's written authorization.				
N/A					

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 MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

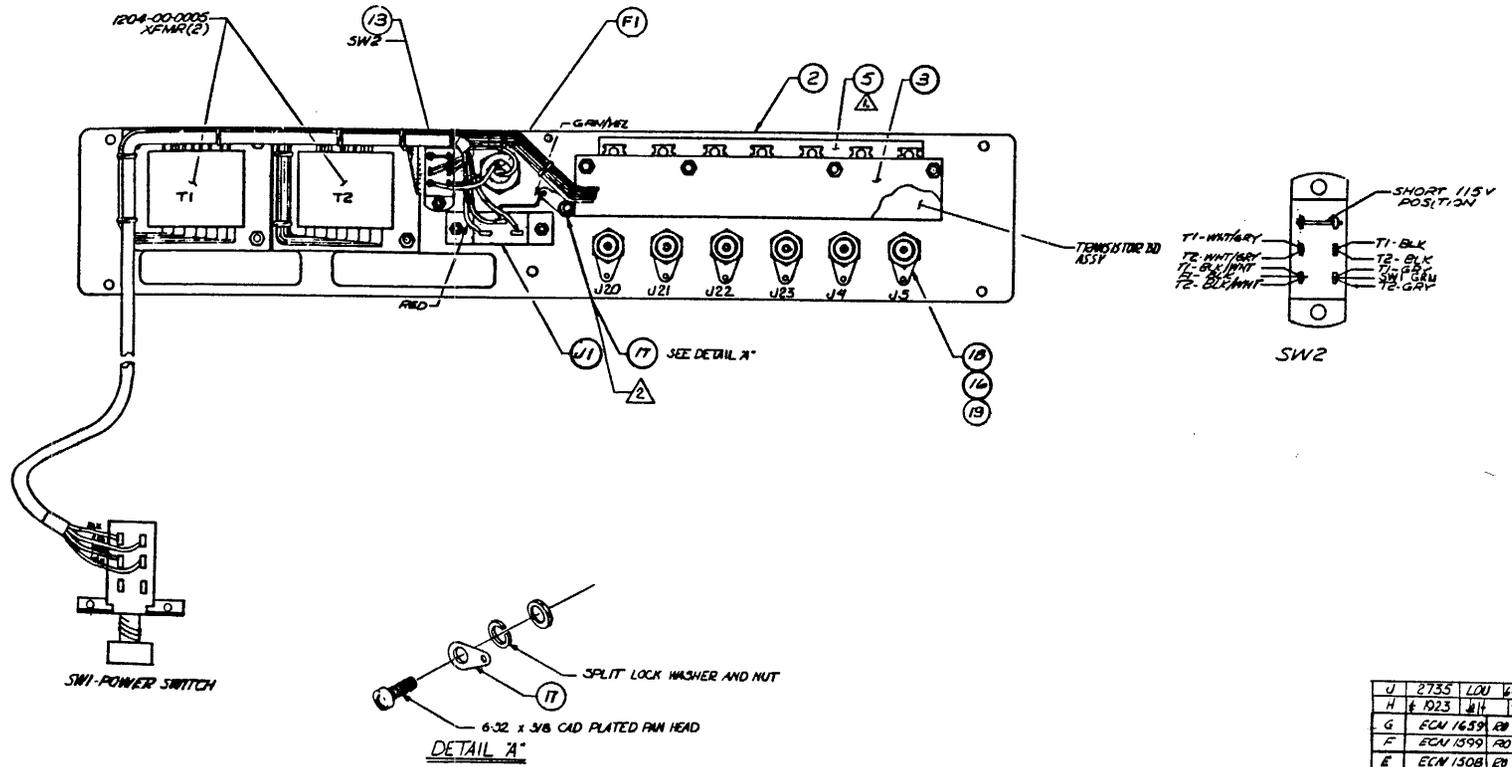
REV ECH BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	QTY-WFR-PART-NO	WFR	WAVETEK NO.	QTY/PY
NONE	TRANS MOUNTING	15A-117	HVTE	1700-00-0087	1
CR1 CR10 CR11 CR12 CR13 CR14 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	DIODE	BCE-1	SEWIC	4881-02-0001	10
Q1 Q3 Q5 Q7	TRANS	TIP-29	TI	4902-00-0200	4
Q2 Q4 Q6	TRANS	TIP-30	TI	4902-00-0300	3

WAVETEK PARTS LIST	TITLE 212TH HTS 80	ASSEMBLY NO. 1100-00-0087	REV
		PAGE: 1	

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DESIGNED	DATE	WAVETEK SAN ANTONIO, CALIFORNIA
MATERIAL	PROTECTOR	TITLE	
	RELEASE APPROV		TRANSISTOR MOUNTING BOARD
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± 0.10 ANGLE ± 1° XX - 0.05	MODEL NO	
	DO NOT SCALE DWG	SCALE	
		154	1100-00-0087
		23338	23338



△ APPLY THERMAL COMPOUND TO ITEM 5 (BETWEEN REAR PANEL AND INSULATOR)

△ ALL CONNECTORS TO BE MECHANICALLY SECURE TO CHASSIS PRIOR TO SOLDERING

NOTES: GROUND WIRES TO LUGS.

U	2735	LDU	6-9-81K7
H	1023	HLH	7-8-79(K-2)
G	ECN 1659	ED	1-8-77
F	ECN 1399	ED	9-2-77
E	ECN 1508	ED	8-3-77
D	ECN 142	ED	8-7-76
C	ECN 102	ED	4-19-76
B	485	ED	7-27-75
A	401	ED	3-2-74

DATE	REV	BY	CHK	APP
11/2/00	1			
WAVETEK				
154 REAR PANEL ASSY				
154 0102-00-0331 U				

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REV	FOR	BY	DATE	APP
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REFERENCE DESIGNATOR	PART DESCRIPTION	ORIG. P/N OR PART NO	P/N OR	WAVETEK NO.	QTY/PK
NONE	ASBY DRWG. REAR PANEL	0102-00-0031	WVTK	0102-00-0031	1
T1 T2	TRANSFORMER	142-500	WVTK	1204-00-0005	2
NONE	END BELL	110-332	WVTK	1400-00-0174	2
2	PANEL, REAR	134-302	WVTK	1400-00-2830	1
3	SUPT. BD	154-312	WVTK	1400-00-2900	1
3	INSULATOR	154-314	WVTK	1400-00-2910	1
NONE	I. D. LABEL	1400-00-9100	WVTK	1400-00-9100	1
J30 J21 J22 J23 J4 J5	BNC CONN	KC-7944	KING	2100-01-0002	6
J1	RECEPT. POWER	EAC-301	SMCFT	2100-03-0005	1
18	SOLDER LUG	1497	SMITH	2100-04-0012	6
17	SOLDER LUG	1483-4	SMITH	2100-04-0025	1
F1	FUSE, 1/2A, 250V	313, 300	LITFU	2400-05-0010	1
10	FUSE HOLD	031, 1453/031, 1444	SCHUR	2400-05-0012	1
19	WASHER, SHOULDER	2448	SMITH	2800-27-0004	6
16	NYLON FLAT WASHER	2264-N-385	ANTON	2800-28-0005	6
8M2	SWITCH ASBY SLIDE	44256-LF	SMCFT	5103-00-0002	1
12	SOLDER GUARD	44256-LF-08	SMCFT	5103-09-0001	1

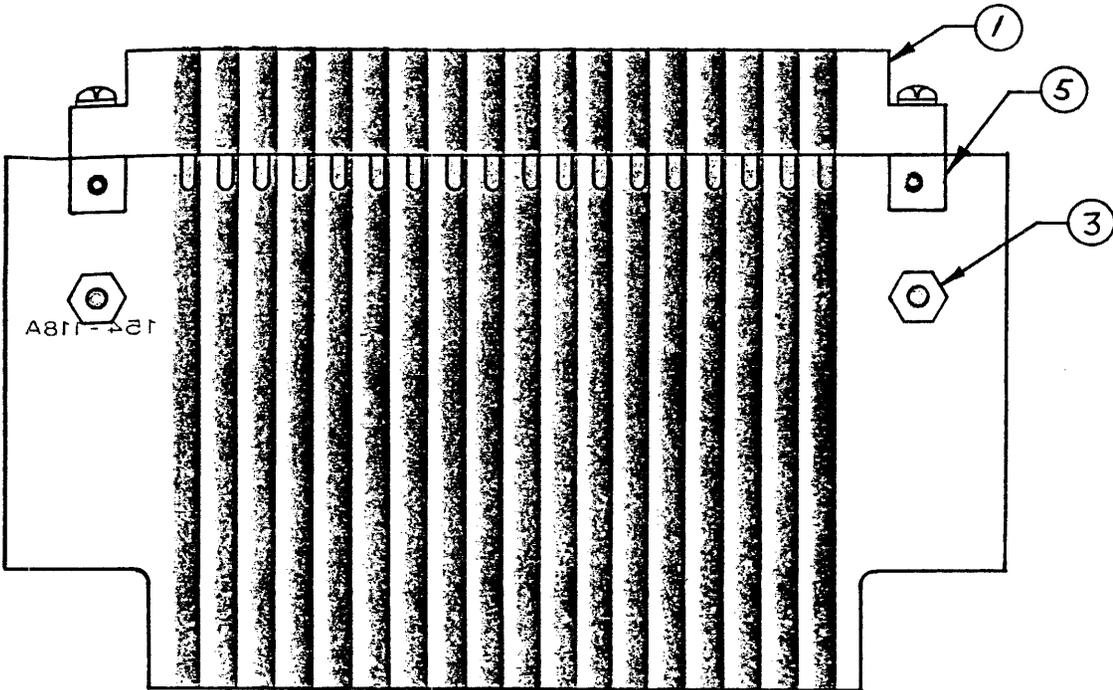
WAVETEK PARTS LIST

TITLE REAR PANEL ASBY
 ASSEMBLY NO. 1101-00-0072
 PAGE: 1

REV 0

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE	 <p>1101-00-0072</p> <p>REAR PANEL</p>	
MATERIAL	PROGRAM		
FINISH WAVETEK PROCESS	RELEASE APPROV		
SCALE	TOLERANCE UNLESS OTHERWISE SPECIFIED DIA: ±.010 ANGLES: 1:1 XX - 32° DO NOT SCALE DWG		
	REV. NO. 154	DWG. NO. 1101-00-0072	REV. G
	CODE 23338	SHEET	OF



PARTS LIST

ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO.	QTY
1		CONNECTOR	CINCH	252-18-30-160	1
2					
3		STANDOFF	USECO	1531-B 3/8	2
4					
5		CHASSIS BLOCK	USECO	1591-B 11	2
6					
7					
8		P.C. BOARD	WAVETEK	154-118A	1
9					

TOLERANCE UNLESS OTHERWISE SPEC	REV	ECN	BY	DATE	APP
ASA 018	WAVETEK SAN DIEGO CALIF BY <i>Gray</i> DATE <i>2/23/71</i> APP				
AS 018					
ANGLES 1/8 W					
SCALE <i>2/1</i>	MATERIAL				
	TITLE <i>A354 EXTENDER BD</i>				
	MODEL NO <i>154B154-01A</i>				
	REV				
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REV ECH BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-WFGR-PART-NO	WFGR	WAVETEK LG.	QTY/PKT
NONE	EXTENDER	154-114	NYTK	1700-00-0000	1
1	CONN. EDGE CARD	252-16-10-100	CINCH	2100-03-0013	3
3 3A	STANDOFF	15310-374	URECO	2800-02-0002	2
5 5A	PART. CHASSIS	1591-011	URECO	2800-04-0021	2

WAVETEK PARTS LIST	TITLE EXTENDER	ASSEMBLY NO. 1100-00-0000	REV
		PAGE: 1	

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE	WAVETEK FAX 909-614-0000
MATERIAL	TITLE EXTENDER BOARD	
FINISH WAVETEK PROCESS	INDUSTRY	
	RELEASE APPROV	
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX - STD ANGLES - 1 E.G. .001	
DO NOT SCALE DIMS	SCALE	
MODEL NO 154	ORIG NO 1100-00-0000	REV
DATE 2004 2247	SHEET 2333B	OF